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THE ROYAL SANITARY INSTITUTE

AND PARKES MUSEUM.

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LECTURES & DEMONSTRATIONS

SYLLABUS OF THE LECTURES

AND

PARTICULARS OF THE INSPECTIONS & DEMONSTRATIONS

ARRANGED FROM TIME TO TIME IN CONNECTION WITH THE COURSES.

Secretary and Director:
E. WHITE WALLIS, F.S.S.

Offices:
90 BUCKINGHAM PALACE ROAD, LONDON, S.W.1.

PRICE TWO SHILLINGS.

September, 1919.

K.G.—500—4/20.

VD 1919

HISTORICAL

THE ROYAL SANITARY INSTITUTE.

COURSES OF INSTRUCTION AND EXAMINATIONS ARRANGED BY THE INSTITUTE.

Lectures to Sanitary Officers.

Courses of Lectures and Demonstrations to Sanitary Officers commence in February and September. The Lectures are arranged to include the subjects scheduled for the examination for Inspector of Nuisances held by The Royal Sanitary Institute and the Sanitary Inspectors Examination Board (formed by The Royal Sanitary Institute and other bodies).

Lectures for Women Health Visitors and School Nurses and for Maternity and Child Welfare Workers.

These two Courses of Lectures have been arranged to assist Women Health Visitors, School Nurses and Maternity and Child Welfare Workers preparing for these Examinations, and for Teachers and others in preparation for the Examination for School Hygiene, including Elementary Physiology.

Courses commence in February and September.

Practical Training for Meat Inspectors

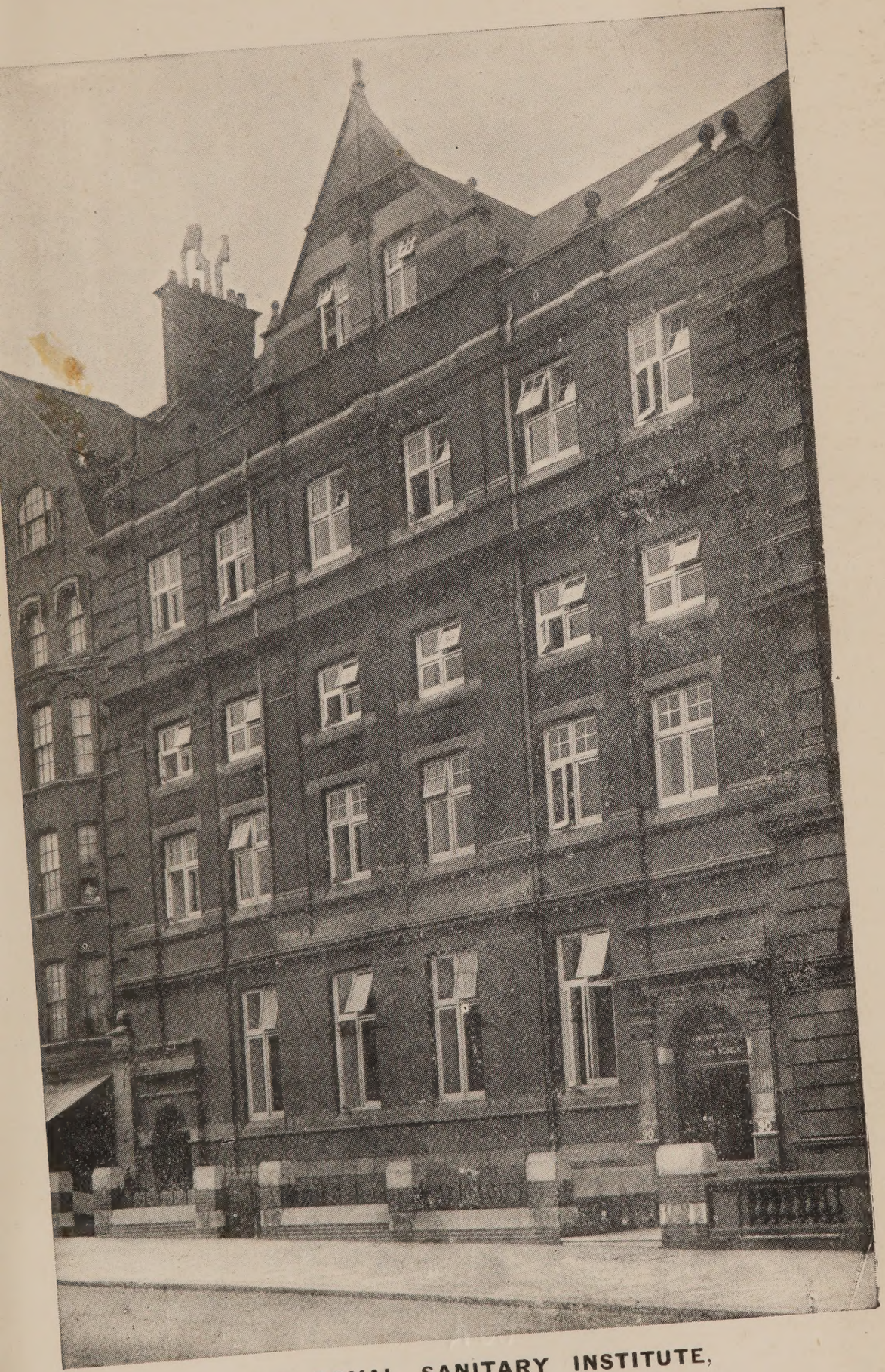
for candidates preparing for the Examination for Inspectors of Meat and Other Foods, conducted by The Royal Sanitary Institute.

Courses commence in February and September, and consist of systematic Practical Training in the Inspection of Meat at a Cattle Market, including Demonstration on live cattle and sheep, slaughtering and dressing of animals, names and situations of the organs, diseases of animals, methods of stalling, arrangements of markets and byres, etc.

The Course will continue for two months.

Special Course on Food and Meat Inspection.

Special Courses of Practical Training in Food and Meat Inspection for Commissioned Officers and Professional Students preparing for the Examination for Inspectors of Meat and [illegible] ducted by The Royal Sanitary Institute, com-[illegible] Mar[illegible].



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GENERAL INFORMATION FOR STUDENTS.

The Museum is open daily from 9.30 a.m. to 5.30 p.m., on Mondays till 7 p.m., and on the days of the Lectures till 6 p.m. The Museum is closed immediately after the Lectures are over.

The Library, which contains nearly all the text books useful to Candidates for the Examinations, besides numerous other handbooks and works of reference, and Sanitary periodicals, is open daily from 9.30 a.m. to 5.30 p.m., on Mondays till 7 p.m., and on the days of the Lectures till 6 p.m. Students can use any of the books on signing the ordinary form. No books can be taken away from the Library of the Institute, but special arrangements have been made for Students to obtain the loan of books (see inside of back cover).

The following pages contain a Syllabus of each Lecture, and some general particulars of the places to which visits have been arranged.

Examinations are held in London in May, July, and December, and in Provincial towns during the year for—Inspectors of Nuisances (under the Public Health Act, 1875)—Meat and Food Inspectors—Smoke Inspectors—Qualifying for Membership (for Inspectors in office)—Sanitary Science as applied to Buildings and Public Works—School Hygiene, including Elementary Physiology—Women Health Visitors and School Nurses—and for Maternity and Child Welfare Workers.

Tropical Hygiene

LECTURES AND DEMONSTRATIONS

FOR

SANITARY OFFICERS.

LONDON COURSE.

LIST OF LECTURES AND SYLLABUS.

(Variations are made from time to time in the titles and order of the lectures.)

PART I.

Public Health Acts—English, Scotch, Irish; other Statutes relating to Public Health; By-Laws (Models, etc.) Regulations, Orders, Memoranda, etc.

How to Read an Act of Parliament—What Acts are necessary for an Inspector to know—Statutory Definitions, *e.g.*, House, Drain, Sewer, Owner, Rack-rent, etc.—Nuisances under the Acts relating to Public Health—Procedure in cases of Nuisance—Forms of Notice—Legal Proceedings—Water and Water Supply; Powers Urban and Rural—Powers of Entry—Public Health Acts (Amendment) Acts, 1890 and 1907; Public Health Acts of Scotland and Ireland—What is a By-Law?—Distinction between a By-Law and a Regulation—Regulations, Orders, and the Model By-Laws.

Public Health (London) Act; Metropolis Local Management Acts; By-Laws and Regulations in force in the Administrative County of London.

The Public Health (London) Act, 1891—The Metropolis Management Acts—London County Council (General Powers) Acts—Procedure in London in connection with Nuisances, etc.—Metropolitan By-Laws made by *(a)* County Council, Compulsory and Optional; *(b)* Sanitary Authority, Compulsory and Optional—Metropolitan Regulations.

Factory and Workshop Act, 1901, as it affects the Sanitary Inspector; Smoke Legislation; Food and Drugs Acts, 1875 to 1899; Butter and Margarine Act, 1907.

Powers of Sanitary Inspectors in connection with Factories and Workshops (including Bakehouses and Laundries)—Homework—Smoke and Effluvia Nuisances—What constitutes a Nuisance from Smoke?—Important provisions in the Food and Drugs Acts and the Butter and Margarine Act—Sanitary Inspectors and Sampling—Law as to Warranties—Prosecutions.

Duties of a Sanitary Inspector—General, A: Indoor.

The Office—Hours of Attendance—Interviews—Correspondence—Keeping of Diaries and other Office Books—Serving of Notices for the Abatement of Nuisances—Framing of Reports—Giving of Evidence in Court.

Duties of a Sanitary Inspector—General, B: Outdoor.

Objects and Methods of Inspection—Observation and Enquiry—Nuisances (General and Special)—General Inspection of a District—Nuisances—Disease—Food—Premises—Dwellings (Movable and Fixed)—Canal Boats—Vessels and Ships—Tents, Vans and Sheds—Hop and Fruit-pickers' Lodgings—Huts and Cottages—Back-to-back Houses—Houses Let in Separate Lodgings—Cellar Dwellings and Underground Rooms—Common Lodging Houses—Model Common Lodging Houses—Block Dwelling Houses, Large and Small—Stable Dwellings—Shelters and Refuges—Other Premises—Schools—Workshops—Slaughter-houses—Cow-sheds and Dairies and Milkshops—Bakehouses, etc.

Duties of a Sanitary Inspector—C: Offensive Trades and Trade Nuisances, etc.

Effluvia—Influence of, on Health: (*a*) of the strong; (*b*) of the weak—Effluvia given off from various Trades—Classification of Trade Nuisances—Methods of dealing with them—Powers of Sanitary Authorities, Urban and Rural, in reference to Trade Nuisances—By-Laws as to Offensive Trades—The more commonly occurring Offensive Trades, and methods by which Nuisances from them may be obviated.

Infectious Diseases.

Definition and Explanation of Terms—Classification and Description of Infectious Diseases—Seasonal Prevalence—Incubation Periods—Susceptibility—Immunity—Methods of Spread of Infection in various Diseases—Preventive Measures against Infection—Notification—Isolation and Quarantine—Duties and Practice of Local Sanitary Authorities and their Officers in respect of Infectious Diseases.

Methods of Disinfection.

The Nature of Infection—The Objects of Disinfection—Definitions of Deodorant, Antiseptic, and Disinfectant—The Properties of the Deodorants, Antiseptics, and Disinfectants in common use, and how they must be employed—The Disinfection of Excreta, Rooms, Clothing and Bedding, Leather Articles, Books, and Polluted Soil—The Relative Values of Hot Air, Superheated Steam, and Saturated Steam as Disinfectants—The Routine of the Work connected with Disinfection by Local Authorities.

Elementary Statistics.

The meaning of Ratios, Means, Averages—The Enumeration and Estimation of Populations—The Density of Population on Area—Age and Sex Distribution of the Population, and its Influence on Mortality-rates—Definition of a Death-rate—Crude and Corrected Death-rates—Zymotic Death-rate—Rate of Infantile Mortality—Birth-rate—Conditions contributing to a High Death-rate—Circumstances which raise the Death-rates of Towns above those of Rural Districts—The meaning and value of a Life Table—Some frequent Fallacies Exposed.

Physics and Chemistry.

(Four Lectures.)

Motion—Force—Chief Forces of Nature—Gravity—Cohesion—Chemical Attraction—Specific Gravity—Centre of Gravity—Physical Properties of Gases, Liquids, and Solids—Boyle's Law—Heat—Radiation—Conduction—Convection—Physical Effects of Heat and Cold—Evaporation—Condensation—Freezing of Water—Latent and Specific Heat—Charles' Law—Explanation of Principles of Physical Instruments—Barometer—Thermometer—Syphon—Pumps, etc.

Explanation of Chemical Terms—Chemical Combination—Symbols—Combining Weights.

Air—Oxygen—Oxidation—Combustion.

Carbon—Carbonic Acid—Methods of Detection—Nitrogen—Presence in Organic Substances—Ammonia—Nitrous and Nitric Acids—Nitrification.

Water—Organic and other Pollution—Ammonias—Nitrites and Nitrates—Differences between Bacteriological and Chemical Analysis—Detection of Poisonous Metals.

Meteorology.

Climate and Weather—Instruments used for Meteorological Observations — Temperature — Wind — Moisture — Clouds — Rainfall—Sunshine—Weather Charts—Influence of Climate upon Health.

Principles of Calculating Areas, Cubic Space, &c., Interpretation of Plans, and Scales.

Standard Units for Lengths—Weights, and Capacity—Determination of Position—Measuring Lines, Surfaces, and Solids—Ascertaining Cubical Contents—Explanation of Scales—Plans, Elevations, and Sections—Isometrical Projection—Contour Lines—Ordnance Maps, etc.

Building Materials and Construction.

GENERAL LINES OF CONSTRUCTION.

Concrete Foundations.—Lime—Cement—Sand—Ballast and Substitutes—Brick.

Walls.—Stone—Timber—Plaster.

Damp Courses.—Asphaltes—Slates—Felts—Terracotta.

Floors, Roofs, Staircases.—Timber—Iron and Concrete—Boarding and Wood Blocks — Cements — Mosaics — Slates — Tiles—Lead—Copper—Zinc, etc.

Building Sites, Construction and Sanitary Planning of Buildings.

Healthy and Unhealthy Sites—Subsoil—Aspect—Trees—Window Space—Internal Courts—Central Well-holes—Position of W.C.'s and Lavatories.

Planning of Houses and Cottages—Model Dwellings—Back-to-back Houses—Factories—Schools—Hospitals—Workhouses.

Sanitary Appliances.

Extent of Lecture, and Functions of Sanitary Fittings—Essentials in the design and make of good fittings—Examples of bad appliances, and risks involved by their use—Water Closets—Slop-water Closets—Trough Closets—Traps—Sinks—Baths and their Fittings—Lavatories—Urinals—Flushing Cisterns—Fixing, Testing, and the necessary attention to the maintenance of sanitary fittings in satisfactory working order.

Details of Plumbers' Work.

Service Pipes.—Materials—Connection with Main—Ball, Stop and Emptying Cocks—Fixings—Protection from Frost.

Cisterns.—Materials—Connections—Overflow and Cleaning-out Pipes—Position—Management and Care—Electrolysis of Metals.

Soldered and other Joints.—Wiped—Copper Bit—Slip—Expansion.

Soil Pipes.—Materials—Fixings—Sizes—Position—Branch Joints—Lead to Iron—Joints to Drains—Vent Pipes.

W.C.'s—Fixing of various kinds.

Waste Pipes.—Materials—Fixings—Sizes—Position—Disconnection.

Baths, Sinks, and Wash-basins.—Fixing—Safes—Overflow Pipes—Traps.

Defects and where to look for them.

Ventilation, Warming, and Lighting.

"Natural" and "Artificial" Means of Ventilation—Air and Cubic Space—Consequences of Overcrowding—Simple Tests for Impurities in Air—Warming inseparable from Ventilation—Perflation and Extraction—Open Fires—Special Grates—Stoves—Hot Water—Steam—Hot Air—Artificial Lighting.

Daylighting—Overcrowding on Space—Model Blocks and Artizans' Dwellings—Back-to-back Houses—Through Ventilation—Angle of Light to Inhabited Rooms—Basement and Cellar Dwellings—Habitable Rooms in Roofs.

House Drainage.

Scope of Lecture—Importance of sound Drainage—Essentials of a good system of Drainage—Design of House Drainage—The Laying of Drains—Size of Pipes, Velocity of Flow, Gradients, Discharge, etc.—Common Defects met with—Materials

used in Drainage Work—Stoneware Pipes, and various kinds of Joints in drain pipes—Iron Pipes—Intercepting Traps, Gullies, Manholes, Inspection Chambers, etc.—Disconnection and Ventilation of house drains—Flushing and Cleansing—Examination and Testing of House Drainage.

Water Supply.

Legislation—Ancient—Modern—Rainfall—Sources of Supply—Evaporation and Absorption—Gathering Grounds—Rivers—Underground Water—Wells Shallow and Deep—Hard and Soft Water—Filtration of Water—Softening Hard Water—Reservoirs—Conveyance and Distribution—Intermittent and Constant Service—the Prevention of Waste, Misuse, and Contamination of Water.

Water: Composition, Pollution, and Purification.

Some Characteristics of Good and Bad Water—Diseases conveyed through Impure Water—The taking of Water Samples—The various Sources of Pollution of Water, and the Precautionary Measures that should be adopted—Solvent Action on Lead, Iron, and Zinc—Hardness of Water and Softening Processes—Domestic Purification—Purification on a large scale.

Sewerage.

Population—Volume of Sewage to be provided for—Rainfall—Separate System—Conditions governing the Sewerage of Towns—Calculation for Sewers—Gradients—Sizes—Construction—Materials—Ventilation and Flushing.

Sewage Disposal.

Discharge into Sea and Tidal Rivers—Disposal on Land—Chemical Treatment—Sedimentation Tanks—Filtration—Bacterial Beds, Percolating Filters, etc.

Scavenging, Disposal of House Refuse.

The Cleansing of Streets—Collection and Disposal of Street Refuse—Cesspits and Cesspools—Pail Closets—Dry Earth Closets—Disposal of Excretal Refuse—The Water Carriage System—Disposal of Slops and House Waste Waters—Disposal of Dustbin Refuse—Disposal of Trade and Factory Refuse and Waste Waters—Refuse Destructors.

PART II.

Signs of Health and Disease in Animals destined for food, when alive and after slaughter. Tuberculin and other Tests.

Signs of health and disease in living animals—General Appearance — Behaviour—Posture — Appetite — Movements—Fatness—Emaciation—Lameness—Salivation —Flow of tears—Nasal Discharge — Breathing—Coughing — Pulse — Temperature—Secretion of Milk—Excretions—Skin.

Signs of disease in dead animals—Mode of death—Effects of bleeding — Putrefaction — Rigor mortis — Anæmia, Dropsy — Discoloration — Spots — Nodules — Adhesions — Swellings — Bruises—Congestion—Inflammation —Post-mortem Staining.

Size and Texture of Organs—Alterations in Form—Parasites, External and Internal.

The Names and Situations of the Organs of the Body in Animals.

Description of the Internal Organs—Organs of Digestion beginning at the Lips and Mouth—The Respiratory Organs. —The Circulatory and Nervous Systems—The Urinary and Sexual Organs—Comparison of these Organs in Animals used for food.

Practical Methods of Stalling and Slaughtering Animals.

Objects of stalling—Condition of cattle after driving—Essential features of properly constructed lairages—Slaughter-houses—Methods of killing cattle, sheep, and calves.

Pigs—Stalling, lairages, and methods of killing.

Diseased Meat, with a Demonstration of Morbid Specimens collected from Meat Markets.

The Appearance and Character of Fresh Meat, and other Foods, and the conditions rendering them, or preparations of them, fit or unfit for human consumption. Preserving and Storing Meat and other Foods.

Characteristics of Good Meat—Inspection of Dead Meat——Preservation of Meat and Other Foods—Emergency Rations — Frozen Meat — Chilled Meat — Substitutions — Signs of

Decomposition—Diseases arising from altered Quality of Meat —Characteristics of so-called Food-Poisoning Outbreaks— Diseases of Animals rendering their Flesh Unfit for Human Food—Signs of Ordinary Inflammation—Parasites—Cysticercus — Life History — Trichinosis — Life History of the Trichina — Fluke, its Life History—Anthrax or Splenic Fever—Actinomycosis—Tuberculosis—Glanders and Farcy— Cattle Plague—Pleuro-Pneumonia—Characteristics of Vegetables, Fish, etc., Unfit for Human Food—Shell Fish and Sewage contamination.

The Hygiene of Byres, Lairs, Cow-Sheds, and Slaughter-Houses, and all places where animals destined for the supply of food are kept, and the Hygiene of Markets, Dairies, and other places where food is stored, prepared, or exposed for sale, and transported.

Construction, Ventilation, Lighting, and General Arrangements of Dairies and Cowsheds, Markets, and Slaughter-houses —Public and Private Slaughter-houses—Description of some Modern Continental and English Slaughter-houses — Cold Storage—Transport of Perishable Food by Rail.

The Laws, By-Laws, and Regulations affecting the inspection and sale of Meat and other articles of food, including their preparation and adulteration.

Duties of Food Inspectors under the Public Health Acts— The Dairies, Cowsheds, and Milkshops Orders—The Public Health Acts Amendment Act, 1907—The Sale of Food and Drugs Acts—The Public Health Act, 1907—Regulations as to Food—The Butter and Margarine Act, 1907—The Sale of Horseflesh Regulation Act, etc.

Continental Methods of Food Inspection.

PARTICULARS OF INSPECTIONS & DEMONSTRATIONS.

Made from time to time in connection with the Lectures.

List of the Places to be visited during the current Course can be had on application.

The following descriptions are supplied from official and authorized sources of information. They afford many interesting and important particulars, but they must not be regarded as fully descriptive or critical accounts of the several works.

L.C.C. MUNICIPAL LODGING HOUSE, CARRINGTON HOUSE, DEPTFORD, S.E.

Particulars supplied by S. G. BURGESS, *Housing Manager, London County Council.* (1919.)

This house was opened in November, 1903, provides accommodation for 802 lodgers, and comprises 5 dormitories containing cubicles above ground floor, and large dining, smoking, and reading rooms, lavatories (hot and cold supply), baths (h. and c.), feet washing room (h. and c.), lodgers' wash-house, barber's, tailor's and shoemaker's shops, dressing rooms, boot brushing space, locker corridors, water-closets and urinals, and administrative quarters on the ground floor.

The cubicles are arranged on either side of the dormitory corridors, with a separate window to each. In order to afford adequate cross and through ventilation, the partitions dividing the cubicles are not extended to the ceiling. All dormitories are divided into sections for the purpose of isolation if necessary. On the first floor, the cubicle partitions are of coke breeze covered with cement, and on the other floors are of wood; there are water-closets and sinks provided on each floor.

All floors are of fireproof construction, and an emergency staircase is provided from the cubicle floors. A lodgers' promenade is provided on the roof of the dining and reading rooms.

A large hot plate and kitcheners are provided in the dining room at which lodgers may cook their own food. Cooking

utensils, basins, plates, mugs are available for the use of lodgers. Cooked and uncooked food may be obtained at low rates from the chop in the dining room.

The building is lighted throughout by electric light.

Hot water is provided by two large steam boilers to the dining room, kitchens, lavatories, bath-rooms, wash-house, and administrative quarters. A steam laundry fitted with modern appliances has been erected for the house on the site.

The administrative quarters comprise general offices, superintendent's quarters, catering premises, bedmakers' day room, and linen and general stores.

The charge for a bed is 9d. per night or 4s. 9d. per week if a weekly ticket is taken, which includes the use of the public rooms and general conveniences. A few specially furnished cubicles have been provided to let at 1s. 1d. per night, or 6s. 6d. per week.

Several cubicles have been reserved for night workers, for use during the day.

BRUCE HOUSE, KEMBLE STREET, DRURY LANE.

Particulars supplied by S. G. Burgess, *Housing Manager, London County Council.* (1919.)

This house was opened in July, 1906, and provides accommodation for 704 lodgers. The building is six storeys in height, and is E shaped above the ground floor, so arranged to provide adequate light and air to the cubicles.

The accommodation and conveniences are similar to those at Carrington House, Deptford, the method of ventilation, and the provision of the means of isolation on the cubicle floors being the same. A special writing room has however been provided at Bruce House, and a disinfecting chamber fitted with steam apparatus also provided. There is a steam laundry, in the basement, fitted with modern appliances, which is used for establishment purposes.

The surfaces of the walls in the principal corridors, staircases, lavatories, kitchens, cold stores, etc., have been finished in glazed bricks or tiles. The public rooms generally have dadoes of coloured tiles 7 feet 9 inches high. The reading and writing rooms are provided with picture panels of prints, framed in teak. The smoking room has coloured pictures, and in the dining room coloured tile pictures with tile frames are provided. The floors of the principal rooms are laid in wood blocks on concrete. The floors and staircases throughout are of fire-resisting construction, and an emergency staircase is provided from the cubicle floors.

The charge is 9d. per night, or 4s. 9d. per week if a weekly ticket is taken, and this charge includes the use of the public rooms and general conveniences. A few specially furnished cubicles have been provided, to let at 1s. 1d. and 1s. 4d. per night, or 6s. 6d. and 8s. per week respectively. The catering arrangements are similar to those provided at Carrington House.

AYLESBURY DAIRY COMPANY'S PREMISES, BAYSWATER.

Particulars supplied by the Company. (1919.)

The extensive block of buildings erected at St. Petersburgh Place, Bayswater, at a cost of over £80,000, and covering more than an acre of ground, were specially devised for all the purposes of dairying and for the reception and distribution of milk, and may be taken as a type of what a milk store ought to be.

They comprise:—Milk, cream, and butter dairies, constructed in accordance with the requirements of the Dairy and Milk Shop Regulation Act, and wholly unconnected with any dwelling-house or living room; a laboratory which is maintained, under the charge of a resident analytical chemist, in order to have the greatest possible control over the quality of the milk; boiler house containing steam boilers of ninety horse power for providing the steam and boiling water necessary for cleansing all vessels used in the dairy; cold-producing and electric plants; workshops for blacksmiths, carpenters, and tinmen; clerks' offices, &c., &c. All portions of these buildings in which milk or its products, cream and butter, are sold or stored, are constructed of impervious materials—glazed bricks, tiles, or cement for walls and ceilings; asphalte, or closely-jointed flagging set in cement for floors; tin for vessels; and marble and slate slabs upon galvanised iron stands for tables and shelves.

To guard against the contamination of milk by disease, an elaborate system of precautions was introduced many years ago. These included the inspection and survey of all dairy farms supplying the company, and the regulation of their drainage and water supply by the District Medical Officers of Health; the enforcement of rigid sanitary precautions in connection with the dairy farms and the persons employed upon them; the continuous medical supervision by the local medical officers of the company of all persons in the employ of the company, numbering over four hundred, and of their families; the analysis of the water used in the dairies on the farms, and a periodical inspection of the various herds by the company's local veterinary surgeons.

THE ROYAL PRIMROSE SOAP WORKS, LONDON, E.

Particulars supplied by MESSRS. JOHN KNIGHT, LTD.

(1919.)

The works cover an area of 8¼ acres of ground at Silvertown, having a frontage of 500 feet on the river Thames, giving great facilities for transit of goods and the loading and unloading of barges. The works are also connected with the Great Eastern Railway by a private siding.

Messrs. John Knight, Ltd., are known as the original inventors and makers of the Royal Primrose Soap, so named primarily on account of its colour, in order to distinguish it from the ordinary dark coloured soaps.

Household and Toilet Soaps of all descriptions are manufactured by the firm, including John Knight's Quick Washer; Flako for fine fabrics and woollens; Family Health and Terebene Soaps for the bath; "Shavallo," a Shaving Soap, and the Natural Bouquet series of Toilet Soaps. The firm's brands of Soft Soap are almost as well known as the Royal Primrose. They are scientifically prepared from pure vegetable oils, the BBB brand being used in clubs, hotels, and large private establishments for polishing silver plate and cleaning glass, and the BB brand for ordinary household purposes. The latter brand is also used by farmers for destroying germs and flies, especially in the hop-growing districts.

Linseed from the East Indies and Canada, and Cotton Seed from Egypt are crushed in the oil mills in large quantities for the oils they produce. The oils are suitable for edible and manufacturing purposes, and the Linseed and Cotton Seed Cakes are unsurpassed as feeding stuffs for cattle.

All the raw materials used are of the best quality obtainable, and these, as well as the resulting products, are tested by the company's own chemists, who superintend the scientific operations of the business.

The melting houses, pan rooms, cutting rooms and other departments of the works are shown to the students, and full information is given of the processes involved in the manufacture of soap.

At these works over 1,000 people are employed, horses and vans, and motor vans being daily engaged; adjoining the works is a large hall, erected for the comfort and recreation of the men.

THE SOAPERY, BOW, LONDON, E.

Particulars supplied by Messrs. E. Cook & Co., Ltd.

(1919.)

The Soapery stands on the banks of the Lee, partly in the Administrative County of London, and partly in the Parish of West Ham in the County of Essex. It has a floor space and ground area of 510,000 square feet, and is fitted with every modern contrivance for making and preparing for the market the high class preparations for which the firm is famous.

There are large offices elaborately fitted. Here can be seen the most modern filing and bookkeeping system, all designed to secure the maximum degree of efficiency.

The works include garages, stables, farriers' and wheelwrights' shops, box making and printing shops, engineers' departments, electric installation house, etc., the whole being connected by a system of narrow and broad tram lines, and every variety of soap is turned out and despatched by motor, van, rail, and water to buyers all over the world.

The first department to be inspected is the Melting House, where edible fats collected from the butchers' shops are melted by steam and made into tallow by a modern set of self-discharging, high-pressure exhausting pans, which, when in full work, give off no trace of steam or vapour.

The sweetest material only is used for the finer kinds of tallow, and the vapours from the various processes are carried away from the vats to furnaces, where they are consumed.

The tallow is pumped over to the Soap House into the huge coppers, where it is saponified with soda or potash ley.

When the soap is made, it is pumped in a liquid state through pipes and shoots into the cooling "frames," where it remains for two or three days to cool and solidify.

The frames, the sides and ends of which are clamped together, are then unbolted, and the solid block of soap cut by wires into first slabs and then bars. Here is made Cook's Primrose Soap and Lightning Soap, the most rapid washer.

In the same department large quantities of soft soap are turned out in neat kegs, drums, and barrels; this soap is largely used for household purposes, and for fruit trees or hop washing.

From he spent soap-leys Glycerine is obtained.

In the "perfumeries" the finest makes of plain soaps are converted into Toilet Soaps by the old process of re-melting, and by the modern plan of "milling." In the former case, the raw soap is cut into small pieces, melted in a steam pan, and then it receives the scent and colour, and any other additions necessary for turning it into a fine Toilet Soap.

In the second case, the hard bars of the very finest white soap are chipped up into small flakes by machinery, and then ground between large granite rollers—the scent and colour being added while cold. By this means many delicate perfumes can be used which would be destroyed, or evaporated, if put into hot soap.

The latter process is particularly useful in the case of medicated and disinfecting soaps, as by its means curative compounds and disinfectants can be thoroughly and evenly incorporated with the soap without the use of heat.

Every branch of soap-making for domestic and manufacturing purposes is carried on at the works, and the firm are also the makers of a very great variety of soaps which are sold under the names of other firms.

The last department to be visited is the Soap Powder Plant, where high-power machinery, driven by electricity, is turning out the company's entire output of Soap Powders, among which is Cook's Washing Powder ("Foap" Brand).

A Bacteriological Laboratory has also been established, under the supervision of trained scientists and chemists, where a study of disinfectants has been carried on in a thorough manner, with the result that the company have put a disinfectant fluid on the market, "Cofectant," which they claim to be superior to all others.

KENSINGTON DISINFECTING STATION.

Particulars supplied by G. M. PETTIT, *M.R.San.I., Chief Sanitary Inspector, Kensington.* (1919.)

The exterior of the building is constructed to a height of four feet with blue Staffordshire bricks, and the upper part with salt-glazed bricks, with terra-cotta dressings. The interior is built to a height of four feet with white-glazed bricks, the walls above being lined with glass tiles. The whole of the structure is impervious to water, so that it may be washed down both inside and out.

The following accommodation is provided:—An Infected Room, 30 feet by 15, for the reception of infected articles, which are then placed in the disinfectors. A Disinfected Room, 30 feet by 20, in which disinfected goods are received from the apparatus. A Laundry, consisting of a washing-room 26 feet by 20, and an ironing-room 23 feet by 20. An air-tight chamber for the disinfection of vehicles which may have become infected. Separate mess-room accommodation is provided, with lavatories and bath-room, on the infected and disinfected side of the building. A boiler and an engine-house. The cost of the building was £4,727.

The apparatus and machinery was supplied by Messrs. Manlove, Alliott & Co. Their estimate amounted to £1,650. The type of disinfector is that known as the "Alliott and Paton Pattern." The disinfecting chamber of each of the two machines is 7 ft. long by 6 ft. high, and 3ft. 7 ins. wide internally. The process consists of:—Firstly, extracting the air from the chamber and its contents by means of an exhausting apparatus; secondly, breaking the vacuum, thus produced by saturated steam; lastly, after the goods have been subjected to the action of the steam at 15 lbs. for fifteen minutes, the steam is allowed to escape and a second vacuum obtained. This is broken by hot, pure air, so that when the goods are removed they are not only sterile but dry.

Such articles as leather, fur, and the like cannot be subjected to steam without damage. These are disinfected in the same machine by formalin vapour introduced through special appliances provided for the purpose, vacuum being produced as in the former instance.

Each disinfector is fitted with a recording pressure gauge, by means of which a chart is obtained of the exact treatment that the goods have received at every operation.

Stained articles, if introduced into the ordinary disinfector, would be removed after steaming with the stains fixed. A rotary sterilizer is fixed, and used with the object of getting over this difficulty. Articles which are received stained, or which for other reasons require to be washed as well as sterilized, are placed in the sterilizer and properly disinfected and cleansed. On removal from the Rotary Sterilizer, the washed articles are taken into the laundry and placed in a hydro-extractor, and afterwards dried in a drying closet and finished in a Decondon ironer. There is also an airing closet, in which articles may be stored after disinfection, which is warmed by means of steam coils. Two vertical boilers are provided as a precaution against stoppages.

Two specially constructed vans are in use, one for the collection of infected articles, and the other for delivering disinfected articles.

THE LAMBETH DISINFECTING STATION.

Particulars supplied by J. PRIESTLEY, *B.A., M.D., D.P.H., F.R.San.I., Medical Officer of Health, Borough of Lambeth.* (1919.)

EQUIFEX DISINFECTION APPLIANCES.

(*a*) SATURATED STEAM DISINFECTION UNDER PRESSURE.—*The Lambeth Borough Council's Disinfector for Absolute Disinfection, Metropolitan Asylums Board Pattern.* These disinfectors are unjacketed, and the steam is kept constantly saturated. The preliminary warming of the objects to be disinfected, together with the expulsion of the air, is effected by current steam under pressure—the new patent valve (introduced by Mr. Wolf Defries) enabling the exact time when all residual atmospheric air has been expelled to be told with absolute precision. The expulsion of air from the pores of the objects is completed by periodically blowing off steam. The objects are dried in the disinfector by a current of air admitted through a valve, such air being warmed by passing over steam pipes, and extracted by a steam jet. As the steam is kept constantly saturated, the variations of pressure correspond to the temperatures, and are recorded on a self-registering gauge, the diagram of which shows at what times and for what periods the disinfection has been conducted.

(*b*) SPRAYERS FOR ROOMS.—Spraying of rooms is intended for use instead of fumigations. The sprayer delivers a disinfectant spray at a high velocity in very fine particles, and each surface to be treated is gone over twice. In this way the disinfectant covers the whole of the surface, while the drops are not sufficiently large to damage even the commonest wall-paper. The disinfectant usually employed is either perchloride of mercury, saturated 1/1000, with a small percentage of salt or tartaric acid, or formic aldehyde solution (40 %), diluted with water to from 20 to 80 parts. These solutions may be scented, if preferred.

(*d*) HOT SPRAYER FOR SHIPS' HOLDS, CATTLE MARKETS, &c.—These sprayers operate by projecting at a very high velocity a fine jet of liquid disinfectant at a temperature considerably exceeding boiling point. Any disinfectant can be used, and the strength is regulated by turning a cock on the apparatus.

(*e*) THE DISINFECTION STATION.—The Station consists of an infected side and disinfected side, kept distinct (administratively and otherwise) one from the other, stables, a bacteriological laboratory, a refuge, an office for the disinfecting staff, and superintendent's house.

ADDINGTON WATER WORKS OF THE CROYDON CORPORATION.

Particulars supplied by GEORGE F. CARTER, *M.Inst.C.E., Borough Engineer.* (1919.)

The Addington Pumping Station is one of four for supplying the Borough of Croydon with water.

The well is 10 ft. in diameter and 205 ft. deep, all in chalk. The well is not bored, but headings or tunnels 6 ft. high and 4½ ft. wide have been made, chiefly about 150 ft. from the top. The total length of these is 813 yards, and they will hold, with the lower part of the well, about 502,000 gallons. Several important water-bearing fissures were cut through in the East headings, the first one yielding 600,000 gallons per day; the maximum yield is about two million gallons per day, and the minimum one million. Pumping to reservoir commenced in August, 1888.

The pumping machinery consists of two engines, each 125 h.p. of the "Woolfe" type, five steel boilers, double acting well and lift pumps of the bucket and plunger pattern. Each engine is capable of lifting 77,760 gallons per hour 250 ft. high, through a 21-in. pipe into the covered reservoir on Addington Hills.

In May, 1910, filters were brought into use for treating the whole of the Addington supply. The three filters have a total area of 4,270 square yards. The water passes through two feet of fine sand and one foot of small gravel.

The rate of filtration is 450 gallons per square yard in twenty-four hours, equal to 8 ft. per day, or 4 in. vertically per hour, giving a little over two million gallons per acre per day.

There is also a softening plant capable of softening 6,000 gallons of water per hour for use at the Croydon Mental Hospital. The softening is effected by adding 10 per cent. of saturated solution of lime to the water. After passing through tanks, when a certain amount of precipitation takes place, the water is passed through filter cloths, and thence to the tank under the pumps. This water is pumped by two steam pumps, each capable of discharging 3,000 gallons per hour into the tank in the Clock Tower at the Hospital.

METROPOLITAN WATER BOARD.

General Description of the Board's Works at Hampton, Walton, and Molesey District.

Particulars supplied by Henry E. Stilgoe, *M.Inst.C.E., Chief Engineer.* (1919.)

These works are situated on land adjacent to the River Thames, on the north side in Hampton-on-Thames and Sunbury Parishes, and on the south side within the boundaries of the Urban District Councils of East and West Molesey and of Walton-on-Thames, and are made up of Intakes, Filters, Reservoirs, Pumping Stations, etc., taken over by the Board from the late Southwark and Vauxhall, Grand Junction, West Middlesex, Lambeth, and Chelsea Water Companies, the whole covering an area of over 600 acres.

Generally speaking the works were commenced immediately after the passing of the Metropolis Water Act of 1852, and have been added to from time to time.

In former times the various Companies had their intakes situated at different points on the Thames ranging from London Bridge up to Kew, but on the passing of the aforementioned Act, they were compelled to take water from the river above the point of tidal influence, which was fixed at Teddington Lock.

At present the works at the above up-river stations include several intakes, from which water is pumped into subsiding reservoirs, where it is stored 30 days, and then gravitates direct on to the surface of sand filters, after passing through which it flows into suction wells, and is pumped up to London, in some cases directly into the service mains, and in others into covered service or storage reservoirs, from whence it is drawn as required.

In the Hampton district—independently of the Kempton Park and Staines pumping stations—several of the principal Thames intakes are situated, and here are installed forty pumping engines, the most recent of these being at the Walton pumping station, which was brought into use in June, 1911.

The engines in the Hampton district total over 12,000 horse power, and have a pumping capacity of upwards of 400 million gallons per 24 hours.

The subsiding reservoirs cover an area at top water-level of 416 acres, with a capacity of over 3,210 million gallons.

There are forty-seven filters, which are situated on the north side of the Thames, and cover a water area of 51 acres.

The filtering medium is composed of from 6 to 9 inches of coarse gravel spread in some cases upon agricultural drain tiles laid close together with open joints, in other cases upon a paving of loosely-laid open brick work, this being followed by a layer of from 12 to 15 inches of finer gravel, the top layer being of sand covering the gravel to a depth of from 2 ft. 6 ins. to 3 ft.

An iron-cased tunnel, similar to the London Tube Railways, connects the north and south sections of the works, two 48 in. steel water mains being laid in the tunnel, to convey unfiltered water from the south side to the filters on the north side of the Thames.

The staff employed on this particular section of the Metropolitan Water Board's works numbers about 460, under a resident engineer, and controlled from the Board's central office at South Place, Finsbury.

METROPOLITAN WATER BOARD EAST LONDON DISTRICT WORKS, LEA BRIDGE.

Particulars supplied by J. M. Wood, *M.Inst.C.E., Engineer (Northern District), Metropolitan Water Board.* (1919.)

At this station there are twenty-five filter-beds, with a joint area of 24¾ acres. The water to supply the filter-beds is brought from Walthamstow by means of a broad open channel. Two deep wells into the chalk have been sunk, and about 7,000 feet of tunnelling has been driven in various directions under the Board's property, yielding a considerable quantity of water of great purity, and not requiring filtration.

In addition to the steam pumping engines, there are two 45-in. Hercules turbines, built by the Holyoake Machine Company, and two 72-in. Girard, built by Günther, of Oldham. These utilise the available water power, and are on the site of the old Lea Bridge Water Mills. These works are lit by electricity.

Walthamstow, etc.

There are thirteen reservoirs, with an aggregate capacity of 5,546,000,000 gallons, and a water area of 906 acres.

The intakes from the River Lea are at Enfield and Ponders End. At the former place 5 Humphrey gas pumps are installed to lift 180 million gallons per diem into the King George Reservoir. Steam driven centrifugal pumps, of a capacity of 120 million per diem, similarly lift the water into the Banbury and Lockwood Reservoirs. The remainder of the reservoirs are filled by gravitation, the water being brought from the intake by open channels, partly natural and partly artificial, and in the latter case lined with masonry or brickwork. There is also a length of brick culvert between Chingford Mill and Walthamstow.

Two large wells have been sunk into the chalk, and headings have been driven to connect these wells. A large supply of water has been met with. Engines are fixed over the wells for lifting the water to the surface. A powerful triple expansion pumping engine, built by Messrs. Harvey & Co., of Hayle, forces water either to the Board's reservoir in Finsbury Park or to Haggar Lane Reservoir.

There is also a steam turbine coupled to centrifugal pumps capable of delivering 5½ million gallons per diem to either of the two reservoirs above named, or alternatively 11 million gallons per diem into the New River at Stoke Newington; thus the supply to that aqueduct can, if necessary, be supplemented from the storage reservoirs.

There are three filter beds at this station.

The pumping engines at Lea Bridge and Walthamstow are of dimensions shown on the following page:—

ENGINES AT LEA BRIDGE.

Name.	Maker.	Date of Erection.	Type.	Engines. Dia. of Cylinders. (Inches.)			Stroke.	Pump Diameter.	Pumps' capacity per minute in cubic feet.
							Ft. In.	Inches.	
Victoria	Harvey & Co.	1854	Cornish	...	100	...	11 0	50	1,500
Prince	Ditto	1867	Ditto	...	84	...	11 0	45	1,100
Princess	Ditto	1867	Ditto	...	84	...	11 0	45	1,100
				High	Low				
Duke	Simpson & Co.	1878	Comp. Rotary	23	39	...	4 5 and 6 6	27	336
Duchess	Ditto	1878	Ditto	23	39	...		19*	550
Horizontal	Mather & Platt	1886	Compound	23	40	...	3 0	22	380
North	Yates & Thom	1891	Triple	20	34	57	4 0	30	1,400
Central	Ditto	1891	Ditto	20	34	57	4 0	30	1,400
South	Ditto	1891	Ditto	20	34	57	4 0	30	1,400
Prince Consort	Harvey & Co.	1894	Triple	21½	33	56	3 3	33	1,400
Well Pump	Hathorn, Davey & Co.	1887	Compound	24	44	...	6 0	22½	400
Ditto	Ditto	1900	Triple	25	37	57	5 0	28	500
Connaught	Simpson & Co.	1900	Triple	19	30	54	3 0	27	1,100
Hercules Turbines	Holyoake Manufact'g. Co.	1885	4 Pumps	...	...	...	1 6	8	110
Girard Turbines	Günther	1890	3 Ditto	...	...	...	2 0	10	100
Ditto	Ditto	1890	3 Ditto	...	...	...	2 0	10	100

* Double Acting.

ENGINES AT WALTHAMSTOW.

Steam Turbine, Ferry Lane	Greenwood & Batley	1907	Delaval System.	...	...	...	...	...	611 or 1,222
Well Pump, Copper Mills.	Hathorn, Davey & Co.	1887	Compound	24	44	...	6 0	22½	400
Ditto	Ditto	1893	Triple	27	40	57	5 0	26	400
Well Pump, Ferry Lane	Ditto	1894	Ditto	24	35	54	5 0	26	400
Ferry Lane	Harvey & Co.	1894	Ditto	21½	33	56	3 3	26	880
Turbine	Holyoake Manufact'g. Co.	1885	Riedler Pump	...	..	...	.....	9½	100

RICHMOND WATER WORKS.

Description by H. W. Apted, *Assoc.M.Inst.C.E.*, *Water Engineer.* (1919.)

Short Description of Works and Plant.

The Borough of Richmond has two separate and distinct supplies : 1st (*a*) Domestic water pumped from a Deep Well in the chalk, (*b*) a shallow well, and Bulk supply from the Metropolitan Water Board.

2nd. Raw Thames Water used only for Road watering, Sewer Flushing, Garden watering, etc.

(*a*) Deep Source of Supply.

There are two deep wells sunk into the chalk, one situated at the Water Lane Works and the other some 750 yards distant at the Terrace Gardens.

These two wells are connected by an adit through the Chalk, other adits are cut in various directions from the bottoms of these wells, the total length being 2 miles.

The Well at the Water Lane Works is 300 ft. deep to Adit level—7 ft. to 4 ft. 6 ins. in diameter from the bottom of the well a borehole starting 14 ins. diameter has been sunk to a depth of 1,400 ft. below ground level.

The Terrace Gardens Well is 320 ft. deep and 9 ft. in diameter.

Plant.

The water is lifted from the deep well at the Water Lane Works by a two-throw pump, diameter of barrels 11½ ins., stroke 40 ins., this pump normally works against a head of 200 ft., discharging into the dummy or Sump well, which is some 100 ft. deep although water can be delivered direct to the surface if necessary.

This pump is driven by a Robey Horizontal Compound Jet Condensing Engine of 30-40 h.p. This set was installed in 1895.

The water is lifted from the Sump well by a 3-throw Pump, diameter of barrels 14 ins., stroke 23 ins., driven by a Compound Jet Condensing Beam Engine of 70 nominal horse power—this set is in duplicate, both were erected in 1876.

The plant at the Terrace Gardens Well was installed by the contractor for sinking this well and driving the adits ; it was afterwards taken over and retained as a standby, it consists of a two-throw pump of approximately the same dimensions as that at the Water Lane Works, and is driven by an Undertype Robey Engine of some 60 h.p.

(*b*) Domestic Supply from Shallow Well.

The water here is lifted by two centrifugal pumps driven by electric motors, these sets are in duplicate. The Motors are 5 b.h.p., and the Pumps are capable of dealing with 350,000 gallons a day each—the lift here is 20 ft. These pumps lift the water on to the Filter Beds at Petersham where, after being filtered, it flows by gravitation to the Sump Well at the Water Lane Works.

River Water Supply.

This is pumped at the Water Lane Works by two Worthington Duplex Compound Direct Acting Jet Condensing Pumps each capable of a maximum delivery at the rate of 9,000,000 gallons per day against a head of 200 feet.

BEDDINGTON SEWAGE WORKS AND IRRIGATION FARM OF THE CROYDON CORPORATION.

Particulars supplied by GEORGE F. CARTER, *M.Inst.C.E., F.R.San.I., Borough Engineer, Croydon.* (1919.)

DESCRIPTION.

The farm and works are situated in the parish of Beddington adjoining the western boundary of the borough.

The farm overlies the Woolwich and Reading beds; the subsoil is chiefly of gravel (very open in some places) and sand. The soil varies considerably, from loam to a light, free, open soil, but all is very suitable for irrigation. The aspect of the farm is a gentle slope from east to west, with an average fall of about 1 in 210. The farm is compact, the inlet or upper side of it being about half a mile from the nearest occupied part of the borough of Croydon, and the outlet side about 450 yards from the river Wandle, into which there are two outlets for the effluent water.

Irrigation on the farm was begun in 1860, and has since been continuous, the amount of irrigable land now being 484 acres out of the gross area of 690 acres.

The sewage from the portion of the borough dealt with enters the farm by two outfall sewers, "Croydon" & "Norbury" respectively, the "Croydon" entering the farm on its east side, and the "Norbury" at the north-east corner.

The estimated area dealt with is:—

	Acres.
From the borough	6,300
From outside areas	3,805
Total ...	10,105

The approximate population at present draining to the farm is 156,000, viz.:—

The "Croydon" outfall (from borough) ...	76,500
do. do. (from outside areas)	14,000
The "Norbury" outfall (from borough) ...	69,500
Total ...	160,000

The average daily dry-weather flow of sewage is approximately:—

	Gallons.
By the "Croydon" outfall ...	... 3,400,000
By the "Norbury" outfall ...	... 1,350,000
Total	... 4,750,000

The average volume of purified effluent discharged into the river Wandle is approximately 4,000,000 gallons daily.

The "Croydon" sewage reaches the works by gravitation, and passes through a system of catch pits and screens, designed to intercept the coarser floating matter and heavy detritus; it afterwards passes through the sedimentation tanks, four in number, 200,000 gallons capacity each, and then flows through a fine screen of 3-32-inch mesh before entering the three underground mains, feeding the 28 sprinkler beds of 80 feet diameter each. Total area 15,400 square yards, 6 feet deep.

The excess over the dry-weather flow, after passing through the screening house, goes over an overflow weir into two tanks of 200,000 gallons capacity each, and then flows along a carrier on to the land to be treated by broad irrigation.

In clearing a tank the liquid is decanted by a floating arm and conducted in a main to the sumps under the "Norbury" engines, where it is pumped into those tanks along with the sewage.

The sludge deposited in the tanks flows by gravitation, or is pushed by manual labour, into channels leading to a sludge well, from which it is pumped into mains delivering on to the land where required, and subsequently ploughed in; 150 acres are available for this purpose.

The "Norbury" sewage passes to the works from the point of entry on the farm, above an overflow weir, which takes the excess over dry-weather flow to the storm water tank.

The sewage passes through a half inch screen, and is then lifted by gas engines and centrifugal pumps, driven by Dowson gas, into a small detritus chamber, then through three sedimentation tanks of a total capacity of 850,000 gallons. The sludge from these tanks is pumped direct into the sludge main and deposited in the same manner as from the other works.

On leaving the tanks the sewage flows along a channel, from which it is led to the 28 sprinkler beds, 56 ft. diameter each (total area 7,560 square yards, 5 ft. deep), also one of 46 ft. diameter (area 200 square yards).

The Norbury storm water passes by gravitation through a tank of 250,000 gallons capacity, situated in the middle of the farm, and afterwards passes on to the land for broad irrigation.

The effluent from both works collects in main channels, which convey it to the several parts of the farm for broad irrigation; it is afterwards collected by pick-up carriers, and finally discharged through the main outfall into the river Wandle.

Irrigation.

The bringing-on carriers at the top of the plots are of concrete from two to four feet wide and level as long as the ground permits. If at any place it is necessary to have a drop this is done by means of a wooden sluice.

Small trenches are made with the plough from the bringing-on carriers down the greatest fall, at a distance from each other of about fifty feet. The ground is a little lower between these trenches to make the sewage spread over the entire surface. Movable galvanised iron or wooden stoppers are used to divert the water at varying distances down the trenches. These trenches end about forty yards from the bottom of the plots, the hollowing ceases, the ground is thus level across, so that the whole breadth of land is irrigated. A pick-up carrier runs along the bottom of the plot, over the edge of, and into which the effluent water passes. The system in use is that of surface or broad irrigation; and, as a rule, the sewage passes over three separate portions of the farm. It first passes over one portion, which is covered with it; from thence the sewage, partially purified, flows to a second portion of the farm, and then to a third, from which it passes in a pure state. The time occupied in passing over the farm is about three hours. It is estimated that two out of every three gallons of sewage pass off the farm as pure effluent water, the other gallon being either evaporated or absorbed by the land and the growing crop. The colour of the Italian rye grass indicates exactly where it has been irrigated; and when ready for cutting the crop should have a uniform dark green appearance.

There is no difficulty in cleansing the sewage in the severest frost. The practice is to flow it over ploughed land that will be sown with mangold, and also over the worst rye grass plots. Ice is formed on the surface, but the sewage flows underneath it, and the purification still goes on, although it requires more area, and the effluent may not be quite so good as at other times.

Crops.

The following is about the average principal cropping of the irrigated portion of the farm:—

Rye grass	...	...	330 acres.
Old pasture	...	...	55 „
Mangolds	...	...	50 „

Rye grass, the largest crop, exhausts itself in about three years, when it is ploughed up and replaced by a crop of mangold or cabbages, followed occasionally by a crop of wheat, oats, or potatoes, and then a return to rye grass. Five heavy crops of the latter are usually grown in a season. The mangolds also are a heavy crop. Wheat and oats are grown chiefly for the straw, which is very strong, and, in consequence, usually laid before the grain is ripe; the expense of weeding and taking to market garden produce militates against its growth on this sewage farm.

EALING SEWAGE AND DESTRUCTOR WORKS, AND NEW BUILDINGS FOR THE PURPOSE OF THE ELECTRICAL INSTALLATION, BATHS, MUNICIPAL BUILDINGS, FREE LIBRARY, Etc.

Particulars supplied by W. R. HICKS, *A.M.Inst.C.E.,M.R.San.I., Borough Engineer and Surveyor.* (1919.)

EALING, W., is situate six miles from the Marble Arch, has an area of 2,947 acres, with an estimated (1919) population of 70,000. There are two sewage works : the one in the northern district was originally an irrigation farm, but has now been converted into a Chemical Precipitation Works, followed by bacterial filtration. In 1913 an adjoining area of 26 acres was added. The Southern Works, to which these particulars apply, take four-fifths of the population. The district was sewered and the works constructed in the years 1863-4 by the late Surveyor, Mr. Charles Jones, M.Inst.C.E., immediately after the formation of the district into an Urban Sanitary Authority.

The works were the first of the sort constructed in the Valley of the Thames, and attracted the notice of the principal sanitary authorities in the country, Professor Way (Royal River Pollution Commission) describing them as "amongst the best, if not the best, in the country."

They consist of precipitation and subsiding tanks, and for some years a small filter bed formed an adjunct. This latter was, however, eventually dispensed with when, in 1868, the works were enlarged, and some extensive subsiding tanks were erected. The tank accommodation is equal to the daily supply of sewage, considerable increase of tank space having been made during the three or four years prior to the outbreak of war.

Originally the sewage was treated with milk of lime and an admixture of carbferalum, the proportion being (per gallon) seven grains of lime and three grains of carbferalum, varying slightly according to the weather. This has now been dispensed with, and the sewage is treated with about three and one-half grains (per gallon) of ferric sulphate. The effluent, after passing through the subsiding tanks, is dealt with bacteriologically in a series of contact beds.

During the year 1904 additional (adjacent) land was purchased, and an extensive system of filtration was adopted, nine single contact beds being constructed. There are also two continuous filters, 57′ 0″ in diameter and 6′ 6″ deep, fed by means of Adams' automatic revolving sprinklers. There is, in addition to these beds, a storm-water tank with a capacity of 1,100,000 gallons.

One important feature at these works is the mode of dealing with the sludge. Up to 1882 this was used by the farmers, a small charge being made for it. In that year difficulty was experienced in getting rid of it, and eventually many hundreds of yards had to be carted to a distance at a great cost. In the year 1883 a Fryer's destructor, with two cells, was built. This was found very successful in destroying both the house refuse and the sludge. In 1885 two additional cells and the now well-known "fume cremator" were erected. The number of cells has now been increased to ten, and forced draught has been applied to all of them. The application of forced draught has so increased the temperature in the cells that it has done away with the necessity for the " fume creator."

In connection with the destructor are two multitubular boilers, which are worked entirely by the heat from the destructor, and which do all the work in connection with the sewage, stone, and sludge-pressing machinery. The necessity for economising the space at the disposal of the Council led to the erection of presses for dealing with the sludge previous to burning. During the year 1912 considerable improvements were made in connection with the destructor platform.

In 1901 a very complete installation of concrete-slab paving machinery was set up, and part of the clinker from the destructor furnaces is thus utilized. It is now possible to make 200 slabs during the ordinary working day.

The clinker and rough ash from the destructor is used in various ways, viz., road and path-making, concrete paving slabs, concrete generally. The clinker, when broken and screened, is also very valuable in the filters; in fact, the whole of the concrete walling and the filter beds have been made from destructor clinker.

In connection with the clinker a mill has been set up for the purpose of crushing, and the material, when crushed, is used as sand in building, and is also useful for sanding tar-slagged roads in time of frost.

Prior to the War tins and rough iron sorted from the house refuse, to the amount of nearly 200 tons per annum, were disposed of loose. They were carted away by a firm of enemy origin, and in consequence of the war this means of disposal ceased, and the material began to accumulate; in fact, the accumulation became so great that a means had to be found to dispose of it. A hydraulic press was erected and was used for pressing the tins into bundles, weighing from 38 to 42 lbs., and a ready market was found for the material treated in this way.

Ealing Electricity Works.

In 1890 the Ealing Local Board decided to light the principal portion of the district with electricity, and obtained a provisional order for that purpose. In the year 1893 Messrs. Bramwell and Harris were requested to report upon the subject, and at the end of the year the consent of the Local Government Board to a loan of £26,000 having been given, tenders were obtained for carrying out the works.

At the present time the street lighting by arc lamps extends over some three and a half miles of road, and 911 posts are fitted with "Osram" lamps in side streets. The private consumers now number 6,295 of whom 1,190 use prepayment meters.

The output of electricity during 1913–1914 amounted to 2,400,240 Board of Trade units, of which 261,475 units were used for street lighting, whilst private consumers took 1,564,243, the maximum load demanded being 1,301 kilowatts.

The effluent water from the adjoining sewage works was used for steam condensing until 1905, when a large water-cooling tower was erected, allowing a certain quantity of water drawn from the town mains to be used over and over again continually, with the addition of a very small daily make-up to replace wastage.

The extensions to main plant, etc., since the works were opened on October 3rd, 1894, have brought the total expenditure up to present date to something over £228,283.

The progress has been so great that the engine and boiler houses have been increased to double their original sizes. Starting in 1894 with three Lancashire boilers of 180 h.p. each, and dynamo machinery (D.C. and A.C.) totalling 250 kw. and of 385 h.p., additions have been made from time to time which bring the present capacity of the plant up to 2,500 kw.

The machinery now consists of—

3	Arc-light dynamos by Messrs. Siemens Bros.,		each	18 kw.	=	54 kw.
2	Exciter	„	„	9·5	„ =	19 „
2	Alternators	„	„	131	„ =	264 „
2	„	„	„	300	„ =	600 „
1	Dynamo alternator	„	„	100	„ =	100 „
2	Alternators	„	„	750	„ =	1,500 „

With engines aggregating 2,360 h.p.

3	Lancashire boilers	each	180 h.p.	=	540 h.p.
1	„ „	„	350 „	=	350 „
2	„ „	„	500 „	=	1,000 „
2	Water-tube „	„	1,000 „	=	2,000 „
		Total horse power			3,890 „

1 Condenser by Messrs. Haslam, capacity 4,500 lbs. steam per hr.
1 „ „ Willans & Robinson, capacity 35,000 „ „
1 „ „ Schwarz „ 37,000 „ „
2 Boiler-feed pumps, by Messrs. Worthington.
2 „ „ „ Weir.
2 large combined feed-water heating, softening, and grease-eliminating plants by Messrs. Paterson.
Economisers by Messrs. Pimbley, and numerous other auxiliaries.

There is also a large Tudor battery of 37 cells.

A notable feature of the last two years has been the very large increase in the number of motors supplied with current.

The trading for the previous twelve months, after payment of all charges, including interest and sinking fund, left a net profit on the

31st March,	1902	of	£420.	31st March,	1909	of	£1,529.
„ „	1903	„	£3,083.	„ „	1910	„	£2,005.
„ „	1904	„	£3,839.	„ „	1911	„	£1,665.
„ „	1905	„	£1,107.	„ „	1912	„	£1,318.
„ „	1906	„	£2,317.	„ „	1913	„	£1,970.
„ „	1907	„	£1,768.	„ „	1914	„	£1,242.
„ „	1908	„	£2,013.				

Public Offices.

The growth of the neighbourhood having necessitated additional office accommodation, as well as enlarged stable buildings, etc., it was decided to erect the present offices, and at the same time to commemorate the Jubilee of Her late Majesty, Queen Victoria, by the erection, by public subscription, of the Victoria Hall, and to arrange a building for the free library, so that the whole scheme might be brought within one general design. The buildings were opened in 1888 by the late King Edward VII. (then Prince of Wales), and answered the purpose till, in 1902, upon the removal of the public library to the Manor House, Walpole Park, the old library premises were converted into additional offices to meet the needs of the increased staff in the various departments of the Council.

During 1912 proposals were considered for the extension of the Town Hall, and during the year 1913 a tender amounting to £3,000 was accepted for the proposed work. This addition is now in use, and provides accommodation for the Electricity and Education Departments, as well as the Inspector under the Shops Act, Employment of Children Act, etc.

Baths, Stables, Fire Brigade Station, &c.

At the rear of the public buildings are the baths, and at the rear of the baths the stabling, with all the necessary departments connected with municipal work, including carpenters' and painters' shops, forge, cart sheds, mortuary and post-mortem chamber, etc. The original outlay upon these buildings was: Public Buildings (including Free Library), £16,000 (of this £7,000 was received from the sale of the old offices); the Victoria Hall, by public contributions, £4,500; Baths, £10,500; Stables and Fire Station, £4,000; or a total of £35,000. On the road fronting the stables was erected a fire brigade station, capable of containing three engines, with residence for the permanent engineer and sleeping rooms for men on night duty.

During the year 1903 additions and alterations were made to the Public Baths by increasing the number of slipper baths to 48 (20 ladies', 28 gentlemen's). The cost of this work was some £2,000.

In 1912 a swimming bath for the exclusive use of the elementary school children was erected, at a cost of £4,000. A novel feature in connection with this bath is the spanning of the bath with a moveable light iron bridge, which facilitates the teaching of swimming considerably.

Slipper baths have also been erected on land secured at West Ealing during the year 1904, and accommodation has been provided for 21 persons (12 males, 9 females).

It is contemplated that in the very near future a block of slipper baths will be erected in the south-western portion of Ealing.

In 1900 the fire station was extended by the erection of stabling for two horses, and sleeping quarters for two additional men. This was carried out at a cost of £500.

In 1903 considerable alterations and additions were carried out at the depot to the rear of the fire station. Stabling for 12 horses was erected (making a total of 40 stalls), painters' and wheelwrights' shops, etc., were erected, and a store, which has been designed for use as a stable should occasion arise. A hospital block for horses was added, and a new drying-harness room with loft over. In addition to the above, cart sheds were also erected, covering a superficial area of nearly 400 square yards. An additional cottage was erected, which is occupied by the Council's storekeeper.

The cost of these additions was £3,000, this bringing the total cost of the buildings contiguous to the Town Hall, and covering some two acres of ground, to £45,100.

The Revenue from the baths and gymnasiums for the year ending 31st March, 1919, amounts to £2,992 per annum, and is increasing.

Public Libraries.

In 1902 the Manor House and Walpole Park adjoining (some 30 acres), the residence of the Percival family, was purchased for the sum of £40,000 for the use of the residents. The Manor House was enlarged and adapted for use as a public library at a cost of £2,500, and upon completion of the alterations the library was removed from its old quarters in the Town Hall to its present position.

In the same year the Council acquired land at West Ealing, and a branch library was erected there, just south of the Uxbridge Road. The building comprises a large news room, and a good-sized reference and lending library.

In 1913 instructions were given for the enlargement of the branch library, and the work was carried out at a cost of £650. It is contemplated that a new branch library for south-west Ealing will shortly be erected.

Isolation Hospital.

In the year 1884 an isolation hospital was erected, an acre and a half of land having been purchased for that purpose. The scheme provided for three separate blocks, together with the necessary administration block, laundry, etc. Only one block was then erected, in addition to the necessary offices. The grounds were laid out as a garden, and arrangements were made by which, in case of emergency, hospital tents could be erected on concrete floors. The entire cost of these works was £6,000, including the purchase of land.

In the year 1902 additional land was obtained, and in 1903–4 two ward blocks, with accommodation for 52 beds, have been erected. The existing ward has been altered, making it into two separate and distinct wards.

In addition to the above a discharging block has been erected.

A novel feature in connection with the new ward blocks is the provision of a large and airy playroom over the centre of the building.

The total cost of the extension, including land, buildings, furniture, laying-out of ground, etc., has been £16,500.

Provision has been made for a possible smallpox outbreak by the erection of a temporary iron hospital on an isolated plot of land on the extreme northern district.

Housing.

In 1899 land comprising 6½ acres was purchased near the South Ealing depot, and in 1901 122 dwellings were erected, consisting of seven different types. The expenditure for the land was £5,250, and for the buildings and roads about £35,000.

In 1918 an additional twenty acres of land was acquired on the Gunnersbury Estate for the purpose of Housing, and a scheme including the lay-out and the houses has been prepared and has been approved by the Local Government Board. The roads and sewers are being constructed, and it is hoped to make an early start with the erection of the buildings.

Miscellaneous.

It is interesting to note that a Charter of Incorporation was granted to Ealing during the year 1901, by which Ealing became a municipal borough. This created a dual record, viz., the first charter granted in Middlesex and the first signed by His Majesty King Edward VII.

It may be noted that when the district was formed in 1863 the rateable value was £17,500. At the present time it is £542,443, and building operations were carried on during the four years prior to the outbreak of war, at an average of 600 houses per annum.

The Parks and open spaces of Ealing now amount to 191 acres, four acres having recently been added to the Hanger Hill Park, and an area comprising 24 acres acquired for the purpose of allotments at North Ealing.

During 1911 a portion of the allotments, amounting to three acres, with frontage on the Uxbridge (main) Road, has been acquired by means of exchange, and has been laid out as a pleasure garden.

Provision has been made in the Lammas Park for 26 lawn tennis courts, 1 croquet lawn, and 2 bowling greens, in addition to the 3 cricket pitches. Refreshment châlets have also been provided, and in the Pitshanger Park lawn tennis courts and 2 cricket pitches.

Public Elementary Schools.

Since 1904 the Council have built and equipped five public elementary schools, having seating accommodation as under:—

	Boys.	Girls.	Infants.
Northfields	400	400	446
Little Ealing	400	400	446
Drayton	300	300	296
Lammas	398	400	420
North Ealing	...	...	400

providing a total seating capacity of 5,006.

In connection with the school for North Ealing the buildings for the senior block have been designed, and will be erected so soon as occasion demands.

Centres have been provided for handicraft, cookery, and laundry work at the Drayton and Lammas schools.

SEWAGE DISPOSAL AND REFUSE DESTRUCTOR WORKS.
(COUNTY BOROUGH OF EAST HAM.)

Particulars supplied by J. E. W. Birch, *M.R.San.I., Borough Engineer and Surveyor.* (1919.)

East Ham is situated in the geographical County of Essex, having within its boundaries, the Royal Albert Docks and the Works of the Gas Light and Coke Company, and is a rapidly growing industrial town. The area of the borough is 3,326 acres, it has a rateable value of £543,000, and an estimated population of 146,526. The following figures show the increase in population during the last 30 years:—

1911	census	133,487
1901	„	96,018
1891	„	32,718
1881	„	10,706

East Ham, prior to 1894, was a Local Board District. In 1894, it was created an Urban District. In 1904, it received its charter of incorporation, and in 1915, reached the highest form of Local Government, and became a County Borough.

Sewage Disposal Works.

The town is sewered on the partially separate system, viz., the rain-water from the back roofs and back yards of houses entering the foul-water sewer, and the remainder being collected by special storm-water sewers. These latter sewers, however, are in some cases connected eventually to the main outfall foul-water sewers, but this state of affairs is gradually being remedied. The original purification works were constructed in 1891, and have been added to from time to time to cope with the increased flow, and to bring them up to date.

The total cost of the works is about £65,000.

There are two main sewers conveying sewage to the works, one from the western and southern part of the district, and one from the eastern and northern part, each being egg-shaped, 3 ft. by 4 ft. 6 ins., and together having a dry-weather flow of about 3,600,000 gallons per day, which is equivalent to about 26 gallons per head of population. The sewage is strong domestic sewage, containing a small proportion of trade wastes.

On arrival at the works, the sewage passes through a screening chamber, equipped with penstocks, bye-pass, etc. On each main sewer there is a manhole containing a fixed screen, 8 ft. by 6 ft., with vertical bars half inch apart. These screens are cleaned by means of travelling rakes which lift the screenings

to a trough above ground level, the screenings thus obtained are then buried.

The quantity of screenings, etc., collected amounts to about $1\frac{1}{2}$ cubic yards per million gallons of sewage.

The rakes are cleaned automatically by a patent rake cleaning gear. The whole of the mechanical part of this work was supplied by Messrs. Stott of Haslingden. The power driving same is supplied by means of a $3\frac{1}{2}$ h.p. vertical engine, connected by shafting from the engine house.

The sewage next flows into a pump well beneath the engine-house floor, from which the sewage is pumped into precipitation tanks.

The pumping plant for the crude sewage consists of: two direct-coupled "Allens" 25-in. twin centrifugal pumps each capable of delivering 20 million gallons per day, driven by high speed (460 revolutions per minute) 165-b.h.p. forced lubricating condensing engines—steam being supplied at 150 lbs. per square inch. Steam is obtained from the Refuse Destructor adjoining.

To one of these sets is coupled, by means of a flexible coupling, a 200 b.h.p. motor, so that should the steam supply fail from any cause, the engine can be uncoupled and the pump driven by electricity.

One "Allens" 18-in centrifugal pump, capable of delivering from 3 million to 8 million gallons per day, under varying heads. This is direct driven through a flexible coupling by a 75-b.h.p. motor, with a speed of 430 revolutions per minute, and voltage of 480. The electric current for all purposes on the Works is obtained from a cable laid from the generating station of the Corporation.

The priming of the above pumps is affected by means of steam ejectors, but an air pump is also provided, belt driven from the 75-h.p. motor.

It will be seen from the above that the motive power for pumping is from two entirely separate sources, and the plant is in duplicate, so that risk from breakdown is minimised to a very small degree.

The total height to which the sewage is lifted, from the normal water level of the pump well into the tanks, is 32 feet.

As it flows into the tanks, it is treated with lime, 4 grains of which is supplied to each gallon of sewage. The lime is delivered on to the works in the form of unslaked stone lime. It is then slaked and mixed with water in a special mixing machine to make milk of lime, in which form it is applied to the sewage before passing into the precipitation tank.

There are two continuous-flow precipitation tanks, 155 ft. by 24 ft. 6 in. by 7 ft. average depth below weirs, having a capacity

of 1,288,000 gallons. Only one tank is in use at a time during dry weather. The sewage flows into and out of the tank over weirs and takes on an average three-quarters of an hour to flow through. Each tank is cleaned out once weekly.

The effluent from these tanks is treated with ferric sulphate in liquid form, to the amount of 3 grains per gallon of sewage. It then flows into one of the three quiescent tanks, each 200 ft. by 50 ft. by 7 ft. average depth, and is allowed to rest in same from two to three hours. The tanks are cleaned out each week, and in dry weather there is always one full, one emptying, and one filling. Provision is made for gravitating the tank effluent back to the pump well, and re-treating it if it contains too high a proportion of suspended solids. The usual amount is about 5 grains per gallon.

The two different chemicals used are—lime, as a precipitating agent, ferric sulphate as a clarifying agent.

The final tank effluent is pumped by two electrically driven centrifugal pumps, each capable of delivering 6 million gallons per day, into a cast iron pipe, 15 in. in diameter, reducing to 12 in. diameter, which encircles the filter beds. From this pipe, branch pipes 9 in., 7 in., 4 in., and 3 in. diameter are laid in lines at intervals of 8 ft. across the bed, and " fixed sprays " are fitted on these pipes at 9 ft. distances apart. The sprays are the invention of Mr. Carpenter, the late Engineer and Manager of the works. These sprays so distribute the sewage that every part of the bed is covered. The filters are composed of refuse destructor clinker, broken to a gauge of 2 in. to $\frac{1}{2}$ in. They are 6 ft. deep, and their total area two acres.

The dry-weather sewage is applied at the rate of 162 gallons per cubic yard per day. In a heavy rainfall the whole of the storm-water is not treated on these filters, but after passing through the tanks, the excess portion flows along a 4 ft. diameter effluent drain to the river Roding.

The beds are under-drained by a false floor made of bricks laid dry and ventilated by 6 in. diameter stoneware pipes, carried up to the surface of the medium, and the channels are covered with Stiff's patent channel covers. The effluent from these beds usually contains about 1 to $1\frac{1}{2}$ grains per gallon suspended matter, but before being discharged into the river, it flows through the humus basin.

A contact bed, one acre in extent, 3 ft. deep, the medium being broken clinker, is provided to purify the supernatant water drawn from the quiescent tanks. The bed is only filled twice a day, the time of contact being immediately preceding low water; the tide preventing the use of this bed in three

cycles of eight hours each day. The effluent from this bed flows into the humus basin.

Humus basin one acre in area. The effluent enters at one corner and flows by a circuitous route over four weirs to a pipe discharging into the main effluent drain. The object of the humus basin is to allow any suspended matter in the filtered effluent to settle, and at the same time to aerate the effluent as much as possible.

The main effluent drain, 4 ft. diameter, discharges into the tidal river Roding at low-water level.

The sludge from the precipitation tanks is swept out by means of squeegees through 12-in. valves into a sludge conduit, and thence to a pump well, whence it is pumped by two Tangyes' horizontal direct acting pumps, having a total lift of 36 ft., into a timber trough, along which it flows at a gradient of 1 in 90 to a lagoon, formed with banks of house refuse, on the marsh. Here the sludge is left to dry. After partial drying, it is covered by surplus refuse not required for burning, and is finally covered by ashes from the destructor.

The total area occupied by the works is 56 acres, of which 18 acres are still available for the disposal of the sludge.

Refuse Destructor.

The refuse destructor adjoins the sewage disposal works, and consists of two units of three cells each, Meldrum's "Simplex" front feed destructor. Forced draught is supplied to the grates by two Keith Blackman high pressure blowers, the motors being self-contained in the fan casing.

The grate area of each unit is 80 sq. ft.

Attached to one unit is a Lancashire boiler, 30 ft. long and 8 ft. 6 in. diameter, with 1,100 sq. ft. of heating surface. To the second is attached a Babcock and Wilcox water tube boiler, 2,255 sq. ft. of heating surface.

The units are worked alternately, one working while the other is being cleaned, thus giving a continuous working of 168 hours per week.

An auxiliary grate is fitted to the Babcock and Wilcox boiler, thus enabling coal to be burned if the refuse is very wet, or too poor in quality to generate the steam required for the works.

The weight of refuse daily destroyed is from 30 to 40 tons, the average weight in Summer being 6 cwts. per cube yard, and in Winter 9½ cwts. per cube yard.

The chimney shaft is 150 ft. high, and 8 ft. internal diameter.

Residuals.

Clinker and ash, about 16 tons daily, used on works. Tins and galvanised ware are disposed of as a saleable product.

HAMPTON SEWERAGE WORKS.

Particulars supplied by SIDNEY H. CHAMBERS, *M.Inst.M.&C.E., M.R.San.I., Engineer and Surveyor to the District Council.* (1919.)

Hampton, in the county of Middlesex, is thirteen miles from London, and being very pleasantly situated on the banks of the river Thames, is a growing and popular district of some 10,500 inhabitants. It has an area of 2,044 acres, of which 1,000 acres are part of Bushey Park.

SEWERAGE WORKS.

The nature of the sewerage system is water carriage, primarily flowing by gravitation and secondarily being raised by plenum pneumatic power. The system embraces some 1,036 acres which are divided into eight sectional areas. The sewage produced in each area gravitates to the lowest point thereof, where it enters Shone pneumatic ejectors and is forced by them to the disposal works. The sewerage is entirely and completely on the separate system. The daily dry-weather flow delivered at the works is estimated to be 300,000 gallons, and is of a strong domestic character. The works were completed in 1898 and have been working regularly since that time.

The purification works comprise a screening chamber, two detritus tanks, a hydrolytic tank, seventeen filter beds, arranged in three terraces, five primary percolating filters, five secondary percolating filters, and seven final contact beds ; and settling tanks, one between the primary and secondary filters, the other between the latter and final contact beds, to arrest the suspended matters flowing from the primary and secondary filters.

The total capital cost of the purification works (including 20 acres of land) up to the present date is £10,000.

The sewage after passing through the screening chamber was formerly treated directly on the triple contact beds, but in 1903, owing to the difficulties incidental to the passing of a screened sewage direct on to contact beds, and on account of the increasing volume of sewage arriving at the works from the growing population, it was found necessary to provide more suitable means for efficiently removing the suspended matter from the sewage. With this object in view, the hydrolytic tank was installed, and the existing screening chamber, into which the whole of the sewage is delivered from the rising main, was raised 18 inches. This chamber was formerly open,

but objectionable odours being emitted into the atmosphere, due to the sewage having been in the rising main for a long period, it was decided to cover and ventilate this chamber as part of the scheme for the general ventilation of the tank and closed channels, on the principle of the hydro-mechanical system of sewer ventilation.

The sewage passing through the screen is conveyed by a covered channel to the detritus tanks. These tanks are in duplicate and are worked alternately. Each has a capacity of 3,000 gallons. The sewage is diverted from one to the other about once a fortnight, and the sludge is removed from the full tank by means of a valved opening, which allows it to pass into the sludge manhole. By this means from one-third to one-half of the total quantity of sludge is removed from the sewage. From these tanks the sewage enters the centre of a transverse channel which conveys it to the sedimentation chambers of the hydrolytic tank by delivering it behind submerged walls which lead it to a depth of 4 feet 3 inches. This tank is divided, by light walls formed of 4-inch self-faced York flagstones, into three compartments, the centre one of which is the reduction chamber, the outer two the sedimentation chambers ; the only means of communication between these chambers are the narrow openings at the bottom of the sedimentation chambers. At the end of the tank is a weir divided into three portions, one for each chamber ; the relative widths of these divisions govern the outflow of sewage from the several chambers, and determine the proportional quantity which flows through each. The side weirs (sedimentation) have a width of 7 feet each, or a combined width of 14 feet, and the central (reduction) weir has a width of 2 feet. The total width of 16 feet is, therefore, apportioned in the ratio of 87·5 per cent. to the sedimentation chambers, and 12·5 per cent. to the reduction chamber.

The tank was designed to deal with 300,000 gallons per day, but it has been amply demonstrated by experience with the tank, and by experiments in the model tank, to be capable of dealing efficiently with a dry-weather flow of 500,000 gallons per day.

As the sewage passes through the sedimentation chambers, the matters in suspension whose specific gravity approaches to that of the liquid travel along a practically level plane, while the lighter and heavier particles describe upward and downward curves, the length of the curve being proportioned to the weight of the particle and the velocity of the flow. The lighter particles rise to the surface and are retained there by the submerged walls at the end of the chamber. The heavier particles in falling, have their curve shortened by the descending volume

of the liquid which passes out of the bottom of the sedimentation chambers into the reduction chamber ; in other words, the natural downward displacement of the particles is accelerated by the downward flow of one-eighth of the entire volume of sewage, by which means the deposit is carried into the reduction chamber. The slower rate of flow in this chamber permits the solids to descend into the lower part of the chamber and prevents so large a quantity of the deposited matters from being carried out of the tank during periods of agitation caused by the gases generated.

The formation of gases is, with almost negligible exceptions, limited to the reduction chamber, and the evolved gases rise to the surface of the liquid either directly or by being directed there by the sloping walls. These walls separate the rising gases in the reduction chamber from the depositing solids in the sedimentation chambers, and thus obviate the confusion in operation which would otherwise ensue. The part of the chamber below the openings at the bottom of the sedimentary chambers is for the reception of sludge ; it is designed to hold the sludge contained in forty days' average flow of sewage. In actual work, however, it holds double this quantity. Along the floor at intervals are fixed valves through which 3,000 gallons of sludge are removed about once a fortnight from the tank into the sludge manhole.

The floating solids on the surface of the liquid in the sedimentary chambers and those floated in the reduction chamber are occasionally, when unduly accumulating, raked over into the detritus tank.

The ventilation of the tank and channels is effected by means of an 18-inch " Sirocco " fan driven by a Marshall's vertical steam-engine, which causes a diminished air pressure in the air duct, channels, and tank, and withdraws the gases as they rise to the surface of the liquid. Atmospheric air is admitted at various regulated openings. The chief opening is situated near the end of the effluent channel, which insures that the maximum quantity of air shall pass over the surface of the liquid after it has left the tank. This volume is increased in the tank by the air admitted at the several regulated openings. The increased volume passes over the surface of the liquid in the tank, and over that in the channel and screening chamber, to the air duct and fan, whence it passes to and through the air-purifying filter fixed over the fan-house, and is discharged therefrom into the atmosphere.

By this means the gaseous contents of the tank and channels are rendered practically inodourous. On the other hand, gases

which have been formed in the rising main and tank cannot escape out of any of the openings leading into the screening chamber, tank or channels.

The sludge removed from the detritus and hydrolytic tanks passes into a 50-gallon Shone pneumatic ejector, which discharges its contents into trenches in the land. These trenches are 3 feet wide, 1 foot 6 inches deep, and 120 feet long, a space of 5 feet being left between each pair of trenches for future utilisation. Half an acre will suffice for twelve months' sludge disposal, which is at the rate of 2 acres per 1,000,000 gallons of daily flow of sewage.

The hydrolytic tank effluent is distributed upon the primary percolating filters by power-driven distributors, and the effluent from these filters, after passing through the settling tank, is similarly distributed upon the secondary percolating filters. The results consequent upon the conversion of the contact beds into percolating filters have been markedly beneficial, for the filter media which required to be removed and cleansed every three years is now self-cleansing, and the effluent from the primary filters alone is superior to that which resulted from the combined primary and secondary beds.

The effluent from the secondary percolating filters passes through a settling tank, and then upon the fine tertiary contact beds.

The final effluent is clear and non-putrescible, the average degree of purification effected being:—

Chemical	...	93·1 per cent.
Bacterial	...	99·6 „

One-third of the effluent is used for boiler feed and condensing purposes at the air-compressing station. It is subsequently discharged with the remaining two-thirds into the river Thames at Hampton Court.

Refuse Destructor.

Adjoining the purification works is a two-cell Horsfall front feed type refuse destructor, which destroys the whole of the house refuse collected in the district. The heated waste gases are utilised to generate steam to drive the machinery at the adjoining air-compressing station.

The total cost of the refuse destructor, including buildings and steam connections, is £2,500.

KINGSTON-UPON-THAMES SEWAGE DISPOSAL WORKS.

By R. Hampton Clucas, *Borough Surveyor, Kingston-upon-Thames.*
(1919.)

Description.

The Kingston Sewage Works are interesting as much as they do not comply with the Local Government Board regulations. The effluent comes within the purification standard required by the Thames Conservancy and the Royal Commission have taken a special interest in this process owing to the percentage reduction of suspended matter in the crude sewage.

These works were built by the Kingston Corporation and opened in 1888, in order to carry out the A.B.C. system of sewage purification operated by the Native Guano Company. They were designed by the Author's predecessor, Major Macaulay, and have now been working 27 years. The scheme was designed without filters and was continuously carried on by the Native Guano Company for many years by tank precipitation only and for some time by single contact filtration. The original cost of the works was £23,000 and they were designed for a population of 35,000 and until 1913 had to be used for a population made up as follows, viz. :—

Kingston	38,440
Surbiton	18,000
Hampton Wick	2,560
	59,000

The agreement with the Native Guano Company terminated in 1908 and since then the Corporation have carried out the system of purification. In 1913 Surbiton agreement expired.

The works at present deal with a population made up as follows, viz. :—

Kingston	38,440
Hampton Wick	2,560
	41,000

Surface water is partly excluded from the sewers.

The average daily D.W. flow of sewage is about 1,759,743 gallons which amounts to an average of 42·9 gallons per head.

The sewage on reaching the works passes into the screening chamber and through gratings $\frac{3}{4}$ ins. mesh, which intercepts coarse matter likely to choke or injure the pumps and thence through a culvert to a pump well under the main building where it receives the purifying mixture.

The size of the pump well is 25 ft. deep and 14 ft. in diameter, the bottom being 4 ft. below the invert of the 4 ft. 6 in. × 3 ft. 0 in. main sewer.

Two storm overflow weirs are provided in the screening chamber one 17·50 above O.D., discharging into a storm water tank 60 ft. × 30 ft., and one storm overflow 18·00 above O.D. discharging into the Thames; the latter comes into operation when the volume exceeds 4 times the D.W.F.; a third storm overflow in screening chamber is provided and controlled by a penstock.

Steam plant for pumping was discontinued after the Corporation took over the works from the Company and Electric power substituted. The charge for power is $\frac{7}{8}$d. per unit.

The sewage partially treated is raised about 12 feet by two motor electrically direct driven pumps, 10 in. Gwynnes, each with a capacity of 2,000 gallons of sewage per minute with a current consumption of 16 units per hour. A third 10 in. pump, Rees Roturbo, is being installed—each pump is provided with hand holes and inspection doors. The pumps are direct coupled to a 20 B.H.P. alternating current Fuller motor. The pumps discharge into a Meter chamber where the sewage is measured by the quantity registered. On leaving the meters the sewage flows along an open channel to the settling tanks receiving on its way the precipitating agents.

One 50 and one 55 h.p. Motors 880 R.P.M. are installed for driving the main shafting and countershafting, the following machinery is driven from the main shafting, viz :—Mortar mills and mixer, 3 air pumps, sludge pumps, water pumps, lathe, compressors and bauxite grinders. The Electric plant was installed under the Borough Electrical Engineer's supervision. The mortar mills are used for grinding the chemicals which are then mixed in two vats and discharged into the pump well. The other vats are used for dissolving the precipitating agents.

Hampton Wick Sewage.

The Author was requested to prepare a scheme to supply Hampton Wick situated on the Middlesex side of the river Thames with compressed air, so as to be able to convey the sewage from Hampton Wick to the Kingston Works for treatment. The following plant was laid down. Two belt driven air compressors each with a maximum capacity of 240 cub. ft. of free air per minute compressed to 15 lbs. pressure. The machines are horizontal 15 in. diameter and 12 strokes each having two pairs of fast and loose pulleys so as to enable the machines to run either of two speeds and each with one automatic air retaining

device. Admission and delivery of the air from the cylinders is regulated by a 5 in. diameter piston valve. The air pipe from the Kingston Works is carried over the Railway Bridge spanning the River Thames to the ejector station at Hampton Wick and a return sewer pipe along the Bridge back to Kingston.

Tanks.

There are eight tanks, each 85 ft. long by 50 ft. broad and 6 ft. average working depth, holding 150,000 gallons or 1,200,000 gallons in the aggregate which gives a capacity of 29·26 gallons per head for the present population of 41,000.

The tanks are partially divided in the middle longitudinally by a wall, about three-quarters the distance of the entire length. The tanks are deeper at the near ends and shallower at the rears, so that the tendency of the sludge deposited is to gravitate towards the front wall, whilst the dividing wall tends to cause the fluid portion to circulate round into the second half of the tank, giving more time to settle before the surplus water runs off by openings controlled by sluice gates. Attached, also to the same front wall of each tank, is a draw-off arm to decant the supernatant water. The water so drawn off is conveyed by an iron pipe to the same place of discharge as the effluent. Another jointed pipe in the same wall is let down into the sump hole and the sludge drawn off by a Tangye-Holman double-action pump at the rate of 500 gallons per minute and ejected into a circular sludge tank, whence it is drawn off as required and conveyed by an iron pipe to 6 iron Vertical accumulators by creation of vacuum, and is then forced by air-pressure at 100 lbs. per sq. inch into 21 filter presses on the first floor of the building.

The pressed cake is sold to the Native Guano Company, the Company paying 1s. per ton, the Corporation delivering into barge alongside the Works. The Company dry the cake which is sold under the name of "Native Guano."

Filters.

From the precipitation tanks the effluent passes onwards through a small settling chamber into a main open carrier to the filter beds. The whole of the single contact beds, six in number, have been converted into percolating filters fitted with sprinklers supplied by the Patent Automatic Sewage Distributors; each bed is provided with four 50 ft. in diameter sprinklers and one 20 ft. in diameter, making a total of 24-50 ft. sprinklers and 10-20 ft. sprinklers the depth of the beds vary from 3 ft. to 3ft. 9 ins. Five additional filters have been constructed using burrs

instead of walls, 4-50 ft. in diameter, and 1-20 ft. in diameter and 5 feet deep. The total filtering capacity of the above filters is 7,566 cubic yards, the maximum rate of filtration being 300 gallons per cubic yard of material. The filtering material of No 4 Filter is broken coke and graded as follows, viz. :—Large coke 18 in. in depth at the bottom, remainder 1 in. to $\frac{1}{2}$ in. graded coke. The material used in connection with the other filters is as follows, viz. :—4 in. gauge clinker 12 in. in depth at the bottom, remainder 2 in. to $\frac{1}{2}$ in. pan breeze.

Results of the Process Employed.

The substances employed are Sulphate of Alumina, Clay and Carbon. From various analyses both of the Albuminoid Ammonia and Oxygen absorption of the tank effluent, the purification effected in the tanks is found to vary from 75 to 80 per cent. upon a crude sewage of normal strength, which contains considerable quantities of gas and brewery refuse. The actual chemical condition of the tank effluent and the filtrate may be gathered from the results of many years' continuous working.

Recent Analyses giving the Following Results :—

	Parts per 100,000		
	Chlorine.	Free NH_3	Albd. NH_3
Sewage	9·0	5·5	1·37
Tank Effluent ...	8·6	4·0	·35
Filtrate	8·3	1·5	·08

The purification being :—

Tank treatment	74·54%
Filtration of tank effluent	77·10%
Total	94·18%

Manufacture of Alumina.

Prior to the Kingston Corporation manufacturing Alumina the Corporation purchased 800 tons per annum of Aluminoferric at 49s. 6d. per ton ; the cost to manufacture Alumina is 30s. per ton which shows a balance in favour of the Corporation of £780 per annum.

SURBITON REFUSE DESTRUCTOR AND SEWAGE DISPOSAL WORKS.

Particulars supplied by HENRY T. MATHER, *Engineer and Surveyor.* (1919.)

The population of the Surbiton Urban District was 17,717 in 1911. These modern works were first put into operation in June, 1913; they are situated about $1\frac{1}{2}$ miles from Surbiton Station, on L. & S.W. Railway main line, and about the same distance from Kingston Station.

REFUSE DESTRUCTOR.

The Refuse Destructor is of Heenan and Froude's back-fed type. There is a drying hearth to each cell so that pressed sludge cake can be and is burnt with house refuse. There are two Babcock and Wilcox boilers each 983 sq. ft. heating surface, fitted with coal-firing grates for use when cells are not at work. Forced draft is obtained by drawing air from the roof, through regenerators set in the flues, to the fan engine. Water-softening plant is by Lassen & Hjort. The house refuse is not quite sufficient for providing all steam required, and a small quantity of coke breeze is burned, principally on Sundays.

SEWAGE DISPOSAL WORKS.

Dry weather flow is 800,000 gallons per day. Average flow throughout year is 1,000,000 gallons per day, and maximum treated at any time through tanks and filters is 2,500,000 gallons in a day. Sewage is purely domestic. There are no trade wastes but several large laundries drain into the sewers.

The sewage is conveyed to the works by means of two new intercepting sewers, the northern or low level sewer conveying the sewage of the portion of the district north of the railway and a small portion on the south side to a pump well on the works. This sewer takes approximately three-eighths of the total flow. The southern sewer conveys the sewage of the remaining portion of the district by gravitation direct into the tanks, and serves that portion of the district on which the future development is likely to take place. The pump well has a capacity of about 25,000 gallons. It is intended that the pumping should be continuous, and therefore no storage is provided beyond that necessary to cope with a certain variation of flow in time of storm. The sewage is screened both at the pump well and at the inlet to the detritus tanks.

Pumping.

There are two sets of pumps in duplicate, one being vertical three-throw pumps, driven by horizontal steam engines, each capable of delivering from 100 gallons to 370 gallons per minute, for dealing with the varying dry weather flow, the other being vertical type centrifugal pump, driven by high-speed vertical engines each delivering 1,000 gallons per minute, for dealing with storm flow.

Air-Compressed Plant.

This consists of two horizontal steam-driven compressors, each capable of delivering 75 cubic feet of free air against a pressure of 120 lbs. per sq. inch with a single fly-wheel, so arranged that in case of a breakdown of one engine the other can be uncoupled and run separately; but usually they are coupled up and run together at low speed. The capacity of the compressor is 150 cubic feet of free air per minute. There is one high-pressure air receiver and a low-pressure receiver which takes the exhaust from the sludge rams for working the sludge ejectors and other plant in the mixing house.

Electrical Plant.

There are two steam driven electric generators, one of 8 kilowatts and one of $11\frac{1}{2}$ kilowatts, for lighting and driving the various motors on the works.

Detritus Tanks.

These are in duplicate, and each has a capacity of 12,000 gallons.

Precipitation Tanks,

of which there are six, have a total capacity of 540,000 gallons. Provisions are made for siphoning off by floating arms the top half of the supernatant water to an empty tank; the remainder flowing into the pump well.

Storm Water Tanks

have a capacity of 180,000 gallons, and are so designed that should it be necessary to increase the number of precipitation tanks, they can be converted with very slight alteration, and fresh storm tanks constructed at the side.

Filters.

There are five primary and five secondary filters 81 ft. in diameter and 4 ft. deep, with a total capacity of 7,897 cubic yards. The floors of the filters are constructed of concrete with channels formed therein, the edges rabbeted for the insertion of perforated stoneware tiles. The channels drain into the main channel running through the centre of the filters. On the average the filters treat 215 gallons per cubic yard and 300 gallons per square yard per day. The filtering medium is hard burnt furnace clinkers of the following grades and thicknesses :— Bottom, 6 in. of 6 in. grade ; 6 in. of 3 in. grade ; 3 ft. of 1 in. grade : the secondary filters being finished with a 3 in. layer of $\frac{1}{2}$ in. grade.

Diverting Apparatus.

By means of an arrangement of siphons the air lock of which is forced by a rise of water in the carrier due to the increased head required to drive the sprinklers, the secondary filters can be automatically turned into primary filters when the amount of sewage to be treated is in excess of a predetermined quantity, and the effluent from the first set of primary filters diverted from the lower set by means of a stop-off dome connected to an air-locking siphon direct to the humus tanks.

Humus Tanks

have a capacity of 90,000 gallons, or two hours' flow. The deposit from these tanks is removed by an electrically driven centrifugal pump. After treatment the effluent is conveyed to the River Thames by means of a 30 in. concrete tube 2,400 yards long.

Sludge is now air-dried on clinker filters.

Mixing-House.

This building contains the recording apparatus for the Venturi meter, sludge ejectors, water supply tank, supplied by a small air-lift pump worked from the ejector exhaust or alternatively by a motor pump, with tank effluent and lime mixer. In the carrier between the mixing house and the detritus tank there is a valve which diverts any excess above three times the dry weather flow to the storm water tanks. The valve prevents any excess above three times dry weather flow entering the precipitation tanks by means of a weir overflow, so set that the floating valve prevents any greater quantity coming through.

SUTTON (SURREY) SEWAGE WORKS.

Particulars supplied by Wm. Hedley Grieves, *M.R.San.I., Engineer and Surveyor to the District Council.* (1919.)

Sutton is a rapidly growing and popular residential suburban town of 25,000 inhabitants, lying eleven miles south by west of London, and in the County of Surrey, and is reached by rail from the Victoria and the London Bridge Stations of the London, Brighton, and South Coast Railway. The area of the district is 1,835 acres, the geological formation being of chalk in the southern half and of London clay in the northern half of the district, a narrow belt of Thanet sand marking the fault.

Sewage Works.

The sewage works were constructed in the years 1891-3, and were designed for chemical precipitation and broad irrigation. The farm comprises an area of 28 acres, the surface of which is composed of London clay and is ill adapted for the purification of sewage.

The average daily flow of sewage delivered to the works is 500,000 gallons. There are two main outfall sewers, a high-level sewer delivering 360,000 gallons by gravitation, and a low-level sewer delivering 140,000 gallons, which latter quantity was formerly lifted by pumps into the high level sewer previous to treatment. Two 8-horse power gas engines were the motive power to drive two pumps of the piston and plunger type of 15 ins. diameter with 15 ins. stroke, each of which, when running at a speed of 36 revolutions per minute, is capable of raising 20,000 gallons of sewage per hour through a seven-inch rising main 660 feet in length against a head of 33 feet; but those are only now used when the tanks are being emptied, for, under the advice of the late engineer to the Council, there has been constructed out of revenue double contact-beds and a percolating filter to treat the low level sewage. The construction of these was a matter of some difficulty, inasmuch as the available fall from the invert of the outfall sewer to the brook was 3 feet 9 inches only. In this depth the contact-beds and percolating filter have been constructed, and the results obtained are quite satisfactory.

The instance is one which illustrates how costly pumping may be obviated by the construction of beds and filters of shallow depths.

Six chemical precipitation tanks, each of 50,000 gallons capacity, were provided and utilised up to November, 1896, the sewage being precipitated by lime and iron in the proportions of 2 grains lime to 9 grains iron per gallon of sewage. After allowing the solids to subside the top water was drawn off, and run on the land for purification or on artificial filters, the sludge being manufactured into sludge cake.

In November, 1896, a coarse-grain bacteria filter for the treatment of crude sewage was constructed, one of the original precipitation tanks being converted for the purpose. This bacteria filter or bacteria bed *was the first of its kind constructed in this country*, and was under constant work from the date named up to July, 1901, viz., $4\frac{2}{3}$ years, treating on an average 25,000 gallons of sewage daily, absorbing 80 per cent. of the sludge from this quantity of sewage without any cost as regards chemicals, and requiring little more labour beyond that of opening and closing the valves, and occasionally turning over the surface of the material.

Important alterations and extensions being requisite in order to provide for the treatment of the whole of the sewage on bacterial lines, the original coarse-grain bacterial bed with an adjacent bed were emptied of their contents and additional beds provided, the site of the original beds being utilised for detritus tanks having a capacity of 100,000 gallons.

The works now comprise eight coarse-grain bacteria beds and eight fine-grain bacteria beds, which are capable of treating the whole of the daily flow of sewage.

The sewage on arriving at the works is passed through the detritus tanks, which serve the twofold purpose of a screen to intercept paper, and also to liquefy the solids in the sewage, preparing it for subsequent treatment on the bacteria beds. The mode of working the beds is as follows: The sewage is turned upon a coarse bed until the liquid rises to within a few inches of the surface, when it is then shut off and the flow turned upon another coarse bed, and so on in rotation. After the sewage has been in contact with the first bed for two hours the outlet valve is opened, and the effluent allowed to flow on to a second bed, termed a fine-grain bed, where it is further purified, the average purification being 85.83 per cent. as regards oxidisable matter in solution, and 78.54 per cent. as regards nitrogenous organic matters. The period of contact allowed in the second bed is two hours. At the end of this period the filtrate is drawn off and passed into a stream, which is a tributary of the river Thames.

Adams' patent automatic charging and discharging apparatus are in use in connection with the beds, and manual labour is reduced to a minimum.

Whilst the Sutton Council acquired the reputation of being the pioneers in the biological system of sewage purification on the "contact-beds" principle, they were not slow to recognise that the continuous or percolating filter system, which was evolved out of the original "contact-bed" system, and which has been adopted in a large number of towns and favourably noticed by the Royal Commission, possessed many advantages, chief of which are :—(1) Reduced cost in construction of filters and maintenance ; (2) Less liability for the material to deteriorate or clog up ; (3) More efficiently purified effluents, and (4) They treat more than double the quantity for each cubic yard of material used. After visiting a number of sewage works where automatic percolating filters were in operation the Council decided to adopt this system for future extensions.

Accordingly since August, 1908, in consequence of the inadequate capacity of the existing filters, it was re olved to put in hand the construction of two percolating filters 80 ft. in diameter and 5 ft. 6 ins. in depth, and these were completed in 1909.

In order to provide for the increased sedimentation which is required, an additional sedimentation tank, having a capacity of 150,000 gallons, had to be constructed, which has entailed a cost of £133, the material from one of the contact beds being removed, and the space thus obtained utilised for the purpose.

The rotating sprinklers adopted were manufactured by Messrs. Adams Hydraulics, Ltd., of York, and this firm also supplied the necessary cast-iron mains, which have been designed of a capacity so as to provide for any additional filters which may be required.

The details of the percolating filters are as follows :—They are circular in form, and have a diameter of 80 ft., and a superficial area of 558 sq. yards each, which are capable of treating 200 gallons per square yard. The floor is constructed of 6 in. of burnt clay ballast and 6 in. of cement concrete, with an open channel 9 in. in diameter running round the outside wall. A retaining wall, 2 ft. in height and 1 ft. 6 in. in thickness, is constructed for the support of the material of the filter, which material consists of 2 ft. 6 in. of clinker of large gauge at the bottom, and 3 ft. of clean pan breeze of a gauge between $\frac{1}{4}$ in. and $\frac{3}{4}$ in. On the floor of the filters there have been laid Candy's drainage tiles, radiating from the centre to the periphery, to conduct the purified effluent to the external channel.

The sewage is conveyed from the sedimentation tank by means of 12 in. stoneware pipes to a chamber, whence it passes

through a syphon consisting of 12 in. cast-iron pipes to a dosing chamber having a capacity of 2,000 gallons, with an automatic syphon. From this point it is conveyed through 9 in. pipes into the central column of the sprinkler, and from thence into the four arms, which consist of 2 in. wrought-iron tubes with perforations, through which the sewage passes on to the surface of the bed, and which arms are caused to rotate by the impetus of the stream of sewage.

The purified effluent collected in the channel is conveyed into an open channel, in which is constructed a settling chamber for the deposition and collection of flocculent humus particles, and discharged direct to the Pylbrook.

A similar filter 80 ft. in diameter but entirely below ground level has been constructed to a depth of 4 ft. at the low level.

It may be interesting to observe that on the sewage farm is cultivated a crop of a somewhat exceptional character, viz., that of the peppermint plant (*mentha piperita*). This plant is raised from cuttings, and attains maturity in the latter part of July or early August, when it is cut, harvested, and the oil distilled from the plant. The oil of peppermint is sold at prices ranging from 21s. to 33s. per lb., and produces a net revenue of about £18 per acre.

All extensions and additions to the works which are yearly being carried out to cope with the increasing flow of sewage are paid for out of revenue.

The nett cost of treating the sewage is extremely low, being slightly under 1d. in the £ on the rates per annum.

In the early part of the year 1912 it became obvious that the two percolating filters at the high-level works were being overworked, and that an additional filter would be absolutely necessary in the near future in order to allow sufficient intervals of rest in which to regain their full efficiency, which is otherwise greatly impaired by continuous working and consequent imperfect aeration. The new works are as follows :—

A humus tank, constructed of cement concrete 10 ins. thick, receives the effluent in the centre by means of 9-in. cast-iron pipes carried on brick piers, which insures complete circulation and settlement of the flocculent particles after the effluent has passed through the three percolating filters ; the grit and heavier mineral particles being intercepted by two grit chambers provided with 4-in. wash-out valves.

The effluent occupies approximately two hours to pass through the humus tank, and finally flows evenly over the weir running the entire length of the four sides, thus providing a length of weir of 140 ft., and insuring a perfectly quiet

overflow into the collecting channel, which greatly adds to the clarification of the effluent by preventing sensible movement in the humus tank.

The effluent then passes along the channels, which are lined with Stourbridge white glazed tiles ; on the main effluent channel a white glazed chamber with gauge weir has been formed.

The humus tank is provided with a 6-in. wash-out pipe for the periodic removal of the small quantity of mineral and heavier flocculent matter which becomes precipitated. The wash-out pipe discharges into two silt lagoons on the south side of the works.

The floor is completely covered with aeration and drainage tiles of the stool pattern, the floor being laid to fall inwards to two collecting channels running across the full width of the bed. This method adds materially to the aeration of the bed by causing an influx of air at the floor level.

Upon the drainage tiles is laid the filtering media of hard selected furnace clinker in two grades, the lowest being 2 in. to 5 in. gauge and spread 1 ft. 6 ins. in depth ; upon this is spread fine clinker to a gauge of $\frac{1}{2}$-in. to 1-in., and of a depth of 2-ft. 8-ins., making a total depth at the present time of 4-ft. 2-ins. of filtering material.

Provision had been made for the addition of another foot of media, if the same is found to be advisable after working the sprinkler for a test period.

The external wall of the filter bed that is above the tile or floor level is built up with specially selected large clinker.

The distributor is of the rotary type, with 3-in. steel tubular arms spraying an area 100 ft. in diameter.

The effective filtering area of the new filter bed is 873 square yards, which is capable of treating sewage at the rate of 174,600 gallons per 24 hours, based on 200 gallons to the square yard.

The capacity of this filter is therefore 56 per cent. greater than either of the two filters previously put down.

The three percolating filters are capable of treating an amount equal to 397,800 gallons per day at the rate previously mentioned.

Since the above was written one new 100 ft. sprinkler has been fixed at the high level works and two at the low level works 66 ft. 6 in. in diameter, and tenders are now being received for the construction of four 36 ft. rotary sprinklers and one 68 ft. diameter. These are to be fixed at the low level works and No. 1 coarse bed is to be converted into a sedimentation tank.

WIMBLEDON SEWAGE WORKS AND FARM.

Description by JOSEPH BOWEN, *M.Inst.M. & Cy.E., M.R.San.I., Borough Engineer and Surveyor.* (1919.)

The district of Wimbledon comprises 3,220 acres, and has a population of 59,531, and a rateable value of £448,621.

With few exceptions the district has a duplicate system of sewers. The surface water sewers take storm water from the roads and front roofs of houses, except in certain portions of the district.

The Sewage Works, Durnsford Road, were constructed on the present site in 1876. These works have since been altered and enlarged from time to time, and now consist of

(1) A Chamber, in which the sewage is received at the works and screened by two Stott's screens, electrically driven ;

(2) A Pumping Station, where the sewage is raised by a plant consisting of three centrifugal pumps, electrically driven ;

(3) A Lime Shed, where milk of lime for precipitation is prepared ;

(4) A series of Settling Tanks, having a capacity of about $1\frac{3}{4}$ million gallons ; equal to one day's dry-weather flow of sewage ;

(5) A Press House, containing four modern and two antiquated sludge presses.

The solid matter deposited in the settling tanks is pressed in the press house into sludge cake, whilst the effluent from these tanks is passed through filters. The areas allotted to such irrigation ground and filters are :

	Acres
For 1st run irrigation ground ...	24
,, 2nd ,, ,, ,, ...	$8\frac{1}{2}$
,, 3rd ,, ,, ,, ...	13
,, 1st filters	3
,, 2nd ,, ...	$3\frac{1}{2}$

The medium in these filters consists of 3 ft. in depth of burnt ballast, drained by subsoil drains about 6 ft. apart ; both ends of each drain are open, and allow a free current of air beneath the filtering material when the filters are not charged.

A considerable quantity of effluent from the settling tanks is run on to a percolating filter 96 ft. in diameter and 4 ft. deep through revolving arms. When the effluent has subsequently passed through an exactly similar filter it is in a condition that admits of its being discharged into the river.

A tank and two acres of filter are provided for the treatment of storm water before such water is passed into the river.

The air for sludge pressing, and also for working two Shone's ejector stations, is compressed at the pumping station by three Lacy-Hulbert air compressors, electrically driven.

The following will be on view :—Experiments in the atomization of sewage, devised by the late Borough Surveyor. The products derived by the Sewage Oil Syndicate (S.O.S.) from the destruction and distillation of sewage sludge.

WELLCOME INSTITUTE LIBRARY 63

LIBRARY.

Arrangements by which Students can obtain the Loan of Books.

Members, Associates and Students of the Institute have the privilege of using books and papers in the Reading Room.

A desire has, however, frequently been expressed that Text-Books and Works of Reference might be borrowed for the purpose of home study.

The Committee have therefore made arrangements with Lewis's Medical and Scientific Library, by which Members, Associates and Students can have the full advantage of this Library by the payment of 5s. for one book at a time for a period of six months, commencing February 1st or August 1st. A deposit of 5s. is also required which is returned at the end of the period.

This Library contains nearly all the books useful to the Students for the Examinations of the Institute, as well as a number of other recent works on Hygiene.

Books can be changed at Lewis's Library, Gower Street, or left with the Assistant Librarian at the Institute, and called for the following day.

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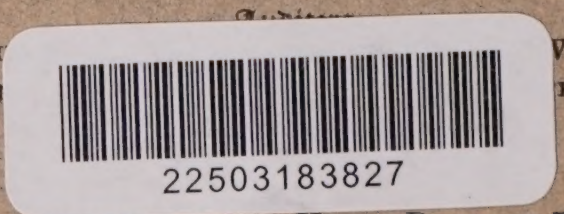

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